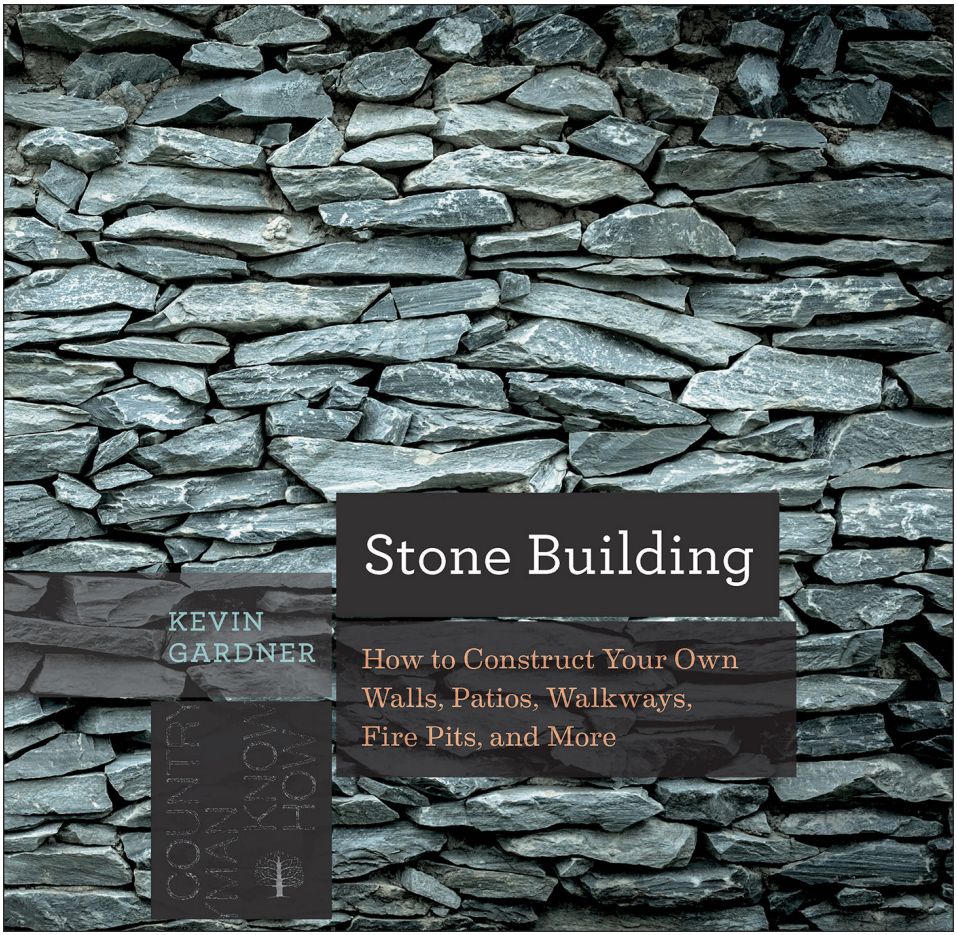
Stone Building
KEVIN GARDNER
How to Construct Your Own Walls, Patios, Walkways, Fire Pits, and More
COUNTRY WAN KNOW HOW

Stone Building

KEVIN
GARDNER

Photographs by Edith W. Currier

How to Make
New England–Style Walls
and Other Structures the Old Way

DEDICATION

For Ruth and Derek Owen—
Farmers, Teachers, Family.

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Antique fence posts and a stepped opening break this double-faced wall to give access to the orchard it helps define.

Why This Book?

There is no shortage of books, pamphlets, articles, and online instruction about building things with dry-laid stone. Most of these resources will teach you the basic principles of the craft in a very short time. It's easy for them to do this because the principles are so simple—and so few. Lay the individual stones of each

succeeding course over the joints between stones in the course below. Place each stone in a solid, stable position, so that it cannot rock or shift when touched. Don't leave unfilled space. Be mindful with each placement of the courses yet to come. Work from the wall to the pile, not the other way around. Build up a project's interior as carefully as you build up the stones that show, so the structure will be fully self-integrated. And so on.

Tidy photographs or drawings accompany these prescriptions. They invariably show crowds of obedient, well-shaped stones, pre-selected for their agreeably docile dimensions and easily interlaced in consistently thick, deep rows over one another as though by predestination. Stones such as these make rules like "two over one, one over two" perfectly clear.

But across much of New England, stones such as these do not exist in anything like the quantities that instructional illustrations imply. Instead, they appear with only intermittent frequency among enormous supplies of rounded misshapen lumps, uneven trapezoidal shards, cloven cannonballs, and a thousand other forms utterly estranged from anything to do with flatness or regularity. How, for instance, can you lay "one over two" when the "two" are so dimensionally unlike each another that they can't offer a shared surface on which the "one" can rest? The essence of New England wall building, then, has little to do with technique itself, which is essentially the same the world over, but with the adaptation of technique to a chaotically obstreperous stone supply that threatens to defeat instructors as readily as it does would-be students of the craft. "New England's rounded granite," concedes one well-known manual, "is a real challenge." That's all it has to say on the subject.

Avoiding the complexities of trying to build walls with stones shaped like footballs, eggs, bushel baskets, and asteroids is easier than it used to be. We're no longer trying to clear off the ground for farming while simultaneously building our walls, so we can afford to select the stones that help and dismiss the ones that don't. The trouble is that the builders who established the style we're trying to imitate didn't enjoy that luxury. Their efforts to use everything that came to hand, to integrate the bizarre with the businesslike, resulted in a distinctly regional style. Those who wish to reproduce that style have no choice but to learn how the old-timers did it if they want their own work to display the traditional, rough-and-ready integrity of the walls that came to define our landscape.

The challenges are equally unavoidable for instructors. A book that attempted to cover every single contingency that could arise when trying to fit New England's mess of mismatched stone into stoutly coherent structures would be a thousand pages long—and even that might not be

enough. Furthermore, the New England style did not simply emerge and remain constant throughout the roughly two-hundred-year period when our enormous network of walls and other structures was largely completed. Beginning in the mid-seventeenth century as a purely practical response to the twin needs for fencing and land-clearing, it developed by the early nineteenth century into a complex marriage of the useful and the symbolic, a regional specialty that expanded its stylistic range as the tastes, motivations, and objectives of its practitioners also changed. Any instruction in the basics of the style is going to have to take these alterations into account if it hopes to create the fullest possible picture of what can be done with New England stonework today.

This is a book, then, that lays out the familiar fundamentals of wall building—and their regional adaptations—entirely from a New England builder's point of view. It addresses site preparation, acquisition and handling of materials, construction techniques both general and specialized, tools and equipment, and ways of managing the learning process. Its illustrations feature typical mixtures of good and bad stone, and they draw distinctions, both technical and visual, among the varied New England sub-styles, from the most primitive to the most discriminating.

The point of it all is to endow you with a sound basis for acquiring the experience that no instruction, however detailed, can provide. There's no shortcut to expertise in this craft; though the curve may be shorter for some than for others, repetition and practice are the only things that will eventually reward you with genuine skill. This book can point you in the right direction, teach you to avoid wastes of time and energy, and alert you to common pitfalls and dubious decisions. It can show you the difference between a wall that's built to last and one that is not. What it cannot do is tell you which stone to put where, next. That, you will have to manage by yourself, with your own eyes and your own hands. No two builders, even highly skilled ones, build their walls exactly the same way. Like the dialogue in a Shakespeare play or the language of the US Constitution, the tenets of dry-laid stonework are subject to interpretation, to personal preference, even to the variable dictates of the stone itself. Discovering those things, while also acclimating yourself to the craft's purely physical demands, the feel and behavior of its materials, and the applied art of seeing what is in front of you, with all its implications and possibilities, is ultimately a process of self-teaching. In New England, where every stone wall, however modest, and every builder, however inexperienced, joins a glorious tradition, these discoveries are only part of your reward.

The ragged surface of a restored single-stack wall makes a forbidding barrier.

“Please don’t make it look too nice!”

During my forty-plus years of stone wall building here in New England, I’ve heard this request from customers more than once. At first it sounded a little odd. After all, is this a thing you would ask the contractor who comes to remodel your kitchen? Or the one who paves your driveway, or paints your house? I joke about it in the talks I give on the craft of traditional New England

> dry masonry: how it caused my family and me to teach ourselves to build walls that appear to be on the verge of collapse but are actually quite sound. It is, I announce ironically, a circumstance unique in the history of the building trades. Why would anyone wish to spend good money on deliberately primitive, almost haphazard work?

But my customers are not asking for shoddy construction. They are asking for authenticity, for stonework that resembles and recalls what they see around them every day across the famous New England landscape. They use the word *nice* not synonymously with *agreeable, attractive*, or *pleasant*—qualities they strongly favor—but in an older sense, meaning *fastidiously careful, delicate*, *precise*, or *overly refined*. Too much of this kind of *nice* looks wrong to them, like a farmer mowing hay in a tuxedo.

Part of their preference is conditioned by observation. The old walls we're so used to looking at are largely unmaintained, and therefore doing what people themselves do as they get older: spreading, relaxing, falling apart by slow degrees, returning to the dust. But more of it is intuitive, because even in a deteriorated condition, New England's traditional stonework has a kind of perfection. It is a perfection of consistency, utility, and persistence, not of finesse or even always craftsmanship. In spite of the semi-ruinous condition of so many of the region's antique walls, they continue to fulfill at least part of their function: to serve as storage structures for uncountable tons of random glacial detritus that would otherwise make farming—and a lot of other things—exceedingly difficult in the northeastern United States.

This fact points to the very thing that makes New England walls distinctive in the world of dry-laid stonework. Their authenticity doesn't come from discrimination but from inclusiveness. The farmers who built most of them were far more concerned—at least at first—with clearing the land than with artful fence-making. Rather than selecting cooperative, well-shaped material from the formless mess of rubble they hauled off their fields and pastures, they made an effort to use as much of it as possible in the walls, wells, culverts, causeways, bridges, and foundations they erected by the thousands across the region.

In doing this, New England's original wall builders created a style. It is often rough, unnecessarily bulky, not overly concerned with flat or tightly fitted faces and surfaces. It does not assign position according to stone size, but tends to use all sizes in all parts of the structure. It employs numerous tricks—trapping, back-shimming, compensation, overbuilding—in order to dispose of huge amounts of junk stone in structures primarily built for longevity rather than artifice. Modern day observers might be

forgiven for concluding that these early builders didn't care very much how their walls looked so long as they did their jobs.

Dumped, thrown, tossed, stacked, laid

The evidence suggests this is not true. Good-looking walls make a good-looking farm, and good-looking farms say something about their proprietors' personal qualities, both as farmers and as citizens. Given the circumstances under which the majority of New England's stone walls came about, perhaps we should reconsider what "good-looking" really meant to the eyes of their builders and original beholders. Like the walls themselves, perceptions of their handsomeness have changed in the 350 years since we started building them.

Single-stack walls were often constructed along roadsides.

New England's agricultural landscape was created out of nothing. Whether on the rocky promontories of the Rhode Island coast, in the fertile floodplain of the Connecticut River Valley, among the roller-coaster hills of central Vermont and New Hampshire, or in the vast forested spaces of inland Maine, our first farmers entered the "howling wilderness" of the Puritan imagination made manifest. This was not, to them, a human place, but a godless chaos of ungoverned fecundity, extreme weather, and

heathen inhabitants. It had to be tamed in order to become the home of decent Christian people. This idea took hold so powerfully that, even two centuries after the first white settlers arrived, one of the most iconic subjects of nineteenth-century landscape painting remained the rude log cabin, dwarfed by an overwhelming scene of wooded mountains and trackless vistas, yet snug in its little stump-pocked clearing, reassuring smoke rising like prayers from its humble chimney.

Sometimes there is a fence in the picture. Usually of pulled stumps or split rails but now and then of stone, it is one of the scene's most important elements. Separating the safe, cleared space from the feral, threatening woods, it is the tamer, the wall of civilization holding back the unholy disorder beyond. In a scene like this, the beauty of a wall, whether of stone or anything else, is that it exists at all. We know the scene will change. The house will grow larger, less primitive; the clearing will expand in all directions; fields of stumps will become grass or plowed acreage; barns, sheds, and even silos will appear; there will be a road someday. But none of these things will mark the place *settled* as clearly or as immediately as the fence. It is the earliest and strongest claim on the land itself. It was this aspect, the part walls played in the larger picture of wilderness transformation, that mattered far more to their first makers than relative degrees of craftsmanship. In this context, roughness is both acceptable and expected.

When we look at this picture, we also see its future. In time, there will be more walls. Perhaps of rails at first, but later of stone, they will grow as the homestead grows, with the same increasing attention to the details of their quality that we'll see in the buildings and on the ground itself. Roughness will remain the calling card of some, but in others we will see a finer sense of form and pattern. As the context in which a wall becomes "good-looking" begins to change, so do the walls themselves.

Commentators as diverse as Eric Sloane and Robert Thorson have pointed out a definite arc of development in the technical sophistication of New England stonework, from the "dumped" wall (unplaced linear mounds) to the "thrown" or "tossed" (rudimentary placement of outside surface stones but a dumped interior), to the "stacked" (relatively careful outside placement, more verticality, partially placed interiors), and on to the "laid" (careful selection and tight placement of outside surfaces, consistent dimensions from end to end, through stones for stability, fully placed interiors with little free space). These distinctions point to phases of preference in wall building that reflect a similar progression in land development, from the primitive struggles of wilderness survival to the settled tidiness of farms and villages in New England's agricultural halcyon days. It's even been speculated that identification of the above types can be used to date wall construction in a given area.

But the story is more complicated than that. First of all, the "types" are nowhere near as pure as their descriptions make them sound. Combinations of partially thrown and partially stacked walls abound. Either of these can easily collapse into shapeless mounds over time, thus looking more dumped than stacked. Laid walls can have loose, sloppy interiors that accelerate their deterioration, or may morph into more primitive types as soon as they pass out of sight of the house. Many walls have loosened up so much, been extensively pilfered or absorbed so deeply into rising forest floors that it's no longer possible to tell what they were when first constructed. Furthermore, because the New England countryside was settled for farming not all at once, but by long degrees over many years, it is likely that lengthy stretches of time passed during which all these types were under construction somewhere, simultaneously. The staggered time frames of settlement, as well as the ways the types can blend into one another, make over-reliance on categorization a bit rigid. Satisfying as definitive nomenclature can be, it does not always accurately capture the reality on the ground.

Nonetheless, over more than 350 years now, the general evolution of New England stonework has followed a more or less steady path from the practical to the decorative. Modern day builders, even those in the restoration business, almost always emphasize form over function, the opposite of original attitudes. The growing professionalization of the craft after about the mid-nineteenth century had something to do with this shift, as did the fresh infusion of traditional skill that arrived with immigrant stonemasons between then and the early decades of the twentieth century. Perhaps most significantly, stone wall building ceased to be an ordinary chore practiced by thousands, and became instead a specialized occupation pursued by a self-selected few. Once farmers stopped building and maintaining their own walls, knowledge of the craft began to confine itself to a much smaller group of people. In 1871, the US Department of Agriculture published a study that found more than two hundred and fifty thousand miles of stone walls in the northeastern United States, the majority built by about eight generations of farm laborers, to whom wall building was deeply familiar, if not a profession. Yet just four generations later, in 1971, Curtis P. Fields could publish a book titled *The Forgotten Art of Building A Stone Wall*, evidence enough of how quickly a once-ordinary chore had become a mysterious "lost" skill.

Fields's book, like the earlier USDA study, appeared on the cusp of a new era. But whereas the Department of Agriculture's *Statistics of Fences in the United States* waved goodbye to the great age of vernacular dry-stone construction by taking inventory of what had been accomplished, *The Forgotten Art* signaled a new enthusiasm for stonework by lamenting what had disappeared. Printed just as fresh waves of residential construction

began to wash over New England's old farming landscapes, Fields's work was one of the first glimmers of a renaissance that today finds many more people engaged in wall building than at any time in the last century or so.

Many of these new builders are professionals, working for landscaping companies or on their own. Some are all-purpose masons, and some specialize in dry-laid work. But almost all of them are oriented stylistically to what our customers think of as the "modern" look, a carefully selected, straight-line, paper-smooth pattern that seeks to make fieldstone behave with the course-by-course regularity of brick or block. Their walls are finely flattened, squared-off, and very tight, not at all reminiscent of the improvisational randomness that characterizes the region's original stonework.

These are the walls that look "too nice" to be authentically New England. Although they are well-built and attractive, their fussy self-consciousness is unsatisfying to those who appreciate the deeper New England landscape: the worn, experienced, even partly tumbled structures that seem almost to emanate from the land rather than impose themselves upon it. Thorson has called them "landforms," a term that nearly implies they are natural features of the topography rather than anything made by humans. The ubiquitous persistence of so many of them in areas where people haven't lived since the middle of the nineteenth century supports this interpretation, especially in the eyes of visitors. "Why did they build all these walls in the woods?" they often ask. They are surprised, even skeptical, when told the woods were once open fields and pastures. The notion that the stone walls are older than the forest seems backward.

In a way, it is. The walls, after all, once replaced the woods, back in the days when both were newly laid down. But when the woods returned, the walls remained, transformed not only by age but by seniority. Formerly the emergent markers of a new world, they are now the weathered legacy of an old one, valued as much for what they remember as for what they are. This is why building and restoring them today not only honors the past but explicates it, creating a continuity of experience that strengthens our shared sense of place in spite of the enormous differences between our lives and those of the walls' originators. To build a stone wall in New England today is to vastly sharpen your appreciation for the accomplishments of our predecessors, whose unmechanized dedication achieved results that seem practically impossible even to those who study them closely.

It's also why so many inspired amateurs have taken up the craft. Whether rehabilitating old work on former farmland or building new landscape walls in more developed areas, they have discovered that traditional stonework is far more than unmitigated drudgery. While it certainly has its moments of tedium and frustration, it also offers

meditative solace and great satisfaction to those whose temperaments allow them to stick with it through the early learning process. Working for the most part without formal instruction, sometimes for many years, avocational wall builders have become significant contributors to the New England tradition. I have been impressed time and again by the quality of their work, which proves better than any other evidence that drystone construction is no arcane mystery but a skill perfectly accessible to almost anyone fortunate enough to have functioning hands, legs, eyes—and patience. Many amateur builders describe walling as a kind of addictive pleasure, one they return to over and over as new projects suggest themselves or old ones cry out for repair. One can only imagine how our exhausted ancestors would feel to learn that the enforced toil of their own time has become a form of recreation for another.

"Use it up, wear it out. Make it do, or do without."

I learned this aphorism from my mother, who grew up on a little family farm during the Depression and World War II. A determined commonplace among people who lived in a time of scarcity and rationing, it also captures something essential to New England's rural character, and, by extension, to its stone walls. Is there a soft spot on that apple? Cut it out and eat the rest. Did the eyelet for the gate-hook break? Drive a nail into the post and hook it over that. Need a sledge to haul some stone? Use the hood from Uncle Jake's old station wagon. Save everything. Waste nothing. Never buy when you can improvise. The poet Donald Hall discovered perhaps the greatest expression of this attitude when he was cleaning out his grandparents' New Hampshire farm and ran across a glass jar full of tiny bits of twine. The label on the jar said "String Too Short To Be Saved," a phrase so drily pithy that Hall used it as the title for his book of youthful memories. His poet's ear undoubtedly responded to the contrariness of it, and perhaps even to the fact that, pronounced with a New England accent, the word *short* sounds like *shot*, an idiomatic adjective that means *defunct, worn out, used up*. On a jar full of saved things not worth saving, even the label is made to do double duty.

It isn't a long leap from *string too short to be saved* to *stone too worn to be used*. The mixed sense of frugal sufficiency, wry self-contradiction, and even pride that underlies Hall's wonderful title shows itself in New England's stone walls as well, not as words but as pattern, proportion, and practicality. In spite of their apparent randomness, our walls are the creations of a sensibility that takes a clear look at its surroundings and

devises ways to get along without dependence on anything manufactured or imported, but by simple rearrangement of what is already at hand. “If I ever go looking for my heart’s desire again,” says Dorothy at the end of *The Wizard of Oz*, “I won’t look any further than my own back yard.”

The stone walls of the Northeast define the region’s old farming landscape as deeply as ever, over a century and a half after most of them were built.

The old style doesn’t put on any airs. It uses what it finds in its own back yard, adjusting its dimensions and its appearance to make itself a haven for large amounts of stone that fancier work disdains. It ages more gracefully than that work because its tolerance for eccentricity in form and fit allows it to absorb the numerous minor disturbances that accumulate in all walls over the years much less noticeably than tighter, flatter structures can. Although it requires a certain degree of craft to ensure its stability and its longevity, it does not seek to display that craft in showy or artful patterns. It lets the stone, not the builder, do the talking. This is how people made stone walls when it was ordinary work for all, not a special skill possessed mostly by elite professional custodians of its secrets. Its vernacular anonymity makes it look old even when it’s new, and because of this it’s right at home in almost any part of the region. This is New England, it says, where we make it do even when it’s not too nice.

CHAPTER 1

The rough traditional face of this double-sided freestanding wall incorporates a variety of shapes and sizes.

Acquiring and Assessing Stone

The business of acquiring stone for the project you have in mind has become more involved than it once was. Builders of forty or fifty years ago commonly ranged along the country roads of New England, helping themselves to any old tumbled wall they came across as long as it wasn't in the front yard of an occupied

home. This is one of the reasons not a few of our rural roadside walls are now so much reduced in size—many to only a third to half their former heights. Nowadays, most local builders don't practice this sort of casual theft as heedlessly as their grandfathers did, but the 'igneous larceny' (in my brother Chris's delightful coinage) continues, if anything more robustly, and even systematically, than before. This is because weathered New England fieldstone, the kind you can only get from antique walls and other structures, has become such a valued building commodity. In great demand for everything from fireplaces to hardscaping to the decorative and sitting walls around gardens and patios, the stones from our old network are showing up in all kinds of new places—some of them far from New England.

Efforts to stop the outright theft of stone have been slow to begin, but they have been gaining traction in recent years thanks to the work of activists such as Robert Thorson and various local organizations, and to increasing public awareness that the walls from which these stones are taken are important parts of New England's cultural heritage—besides being someone's property!

Fortunately, there are plenty of ways to get the stone you want without stealing it. The first thing to do, however, is to determine what kind of stone that is, and how much you really need.

Picking a stone type is partly a matter of aesthetics and partly a matter of structure. Stone dealers in New England now offer a variety of types, in different colors, shapes, and average sizes. Some of these are not from New England, such as Corinthian from upstate New York, or the popular Pennsylvania Flat. These and other imports make perfectly functional wall stone but will not produce the traditional New England appearance. Even weathered old stone acquired legitimately (one hopes) within the region has usually been graded according to average size, and so it is less randomly shaped than a true run of native material, though its colors and surface textures are more familiar than stone from other regions.

Your choice of stone type shouldn't just be influenced by personal preferences for color and texture, however, but also by what it is you're going to build. Straightforward double-faced freestanding walls need lots of good face stones, longer than they are wide, with at least one end that's relatively flat. Retaining walls need fewer of these, and can often be counted on to absorb large amounts of poorly shaped or rounded stones that aren't much help in the wall's face. Steps, butt ends, and corners require considerable numbers of stones with ninety-degree angles to them, some in rectangular or square form at thicknesses up to six or eight inches.

Single-stacks call for supplies of larger stones in general, as many of them as possible in shattered, elongated, or multi-angular form, with very few rounded bushel-baskets or cannonballs. Larger, thicker walls eat up more volume, and so can stand stone supplies that are not as rich in the most helpful shapes. Shorter, smaller walls need larger quantities of cooperative building stone because they have less interior space in which to stash the junk.

When you buy stone from a dealer, most of what you're paying for is the cost of gathering, palletizing, and transport. Dealers are selling convenience as much as the material itself, and this creates markups that can make it formidably expensive for large projects. Purchased this way, weathered New England fieldstone can end up costing as much as six hundred dollars a ton, meaning that fifty feet of two-by-two garden wall may require an outlay of nine thousand dollars or more, just to put its approximately fifteen tons of stone on your site.

A lone natural boulder found its way into this cemetery wall otherwise composed of rough-split blocks.

Fortunately, there are alternatives, especially if you don't mind a little legwork. Stone yards, landscape materials dealers, and other retailers will sometimes share information about their sources, allowing you to skip a step in the markup chain for large quantities. Construction companies doing major excavation projects occasionally sell off piles of blasted rock from their job sites. Active quarries may allow you to hand-pick loads from their immense heaps of tailings for a flat per-load sum.

But if the old weathered stuff, in all its wild random glory, is what you're after, the best way to find it is to make contact with a member of the class of people who possess most of it: private landowners.

This can take some time. Many New Englanders who own land in old farming areas have miles of crumbling walls, abandoned foundations, or even large dumps of discarded stone never used in any structure. While some are uninterested in selling it, others are quite willing to listen to your offer. I know this because I am regularly approached by them at my lectures; ironically, they're often unsure how to go about locating a buyer for the stone they're interested in selling. So this is a case in which both the supply and the demand exist, but without an established market to connect them.

Naturally, opportunities to locate stone supplies are likely to be more numerous the farther away you travel from urban centers. In small towns, sources of information include road agents, mason and landscape contractors, and excavation companies. You can place ads in local papers, post "Will Buy Weathered Fieldstone" inquiries on the bulletin boards at village stores, or spread the word through people in the area you may already know. You can conduct searches on the Internet, too, which may turn up all kinds of surprising opportunities. When you locate a possible supply, you should do three things, in this order: Go and look at it, agree on a price, and arrange for transport.

Look Before You Buy

It's a bad idea to buy any stone you haven't seen. I did this just once, in youthfully ignorant days, and ended up with a ten-wheeler load composed of two-thirds useless bowling balls and one-third dirt because the seller had loaded it directly from the source with a machine instead of hand-picking it. I didn't look, I didn't ask, and as a result I acquired a large pile of lousy stones and a whole lot of really expensive forest loam full of leaves and sticks.

The best situation is one in which the landowner allows you to pick what you want from the wreckage of an existing wall or foundation, or from a dump. Sometimes sellers will stipulate that you remove the entire section, wall, or pile. Even today, farmers are still dozing or burying walls in order to enlarge fields, and developers are removing them to open up sections for house lots. In these cases it's wise to be sure you'll be able to use all that you take, or most of it. But what exactly is it that you're looking for?

Viewing a raw supply of stone with an eye to what you intend to build means classifying its types according to approximate percentages: how much of it is rounded and relatively smooth-surfaced? Is some of it roundish, but rough and abrasive? How much of it, if any, is flat? How

much is broken, shattered, or otherwise angled, sharp-edged, or squared off? Is there a healthy percentage of stones that are longer than half the width of your project? What about small pieces, the chips, shards and angular chunks so useful for filling odd spaces and pinning the bottom sides of overly-rounded builders? It's not necessary to quantify these types by strict numerical calculation, only to note the relative amounts of useful (the flat, the long, the square, the angular, the roughly-surfaced) and difficult (the smooth, the round, the lumpy, the rotten) material in the supply as a whole.

Emphasis in collection can change according to the kind of wall you intend to build, as noted above. But in general, a productive supply of material for most standard applications in New England wall building includes all the shapes and attributes mentioned here. Variety in selection actually improves your chances of creating a sound structure because it ensures you'll have variant solutions for the variant difficulties in fitting that inevitably arise. It is often more challenging to build with stones that are all more or less the same than with those that have a wide range of different shapes (unless, of course, they're all flat). This is especially true when too much of your supply is rounded off or worn to smoothness. Many projects can be made to absorb sizeable quantities of this kind of difficult stone, but if, say, more than a third of it runs to the spherical, you're going to have a tough time making use of it all. As to average size, it's a good rule of thumb not to bother with individual stones that are larger than half the height of the wall you're proposing to build. Unless you're going to hide them within the wall's interior, they'll look out of proportion in the finished project. There are exceptions to this, of course: particularly alluring surfaces or mysterious shapes, flattened rectangles or squares, or boulders used as end stones.

In almost every kind of dry-laid wall, however, the most important stones are the ones we call builders. Without an adequate supply of these, your experience with any project is bound to become a miserable one, sooner or later. Builders are the stones that show, the ones that make up most of the containing outer faces, or 'skin', of the wall. They have three essential qualities: a shape that permits them both to perch soundly in their chosen spots and to offer stable platforms for the stones to come, enough length to pass back into the wall's interior in order to be properly gripped by its mass, and a face that is, if not necessarily flat, at least broad enough to allow the edges of adjacent faces to meet it laterally without leaving unsightly gaps. Ideal face stones, then, often tend to be shaped more or less like loaves of bread. See the top photo on the following page for a group of good-looking ones.

The bottom photo on the following page shows a group of face stones that appear to be useful, but each has a serious flaw. Looking from left to

right, the first is blocky and almost square, but also too shallow. It can be used, but should be laid in between two others that are good and long, so that it will be less likely to be squeezed out of place as the wall settles and ages. The next has a striking triangular face with sheared straight lines, but it tapers so radically from front to back that it's likely to be spit out of the settling wall very soon in the structure's life, like the flesh of a grape being squeezed out of its skin. Its smooth surface will accelerate this process. Number three has a rougher surface that will grip other stones more firmly, but also tapers far too much from front to back. Numbers four and five have plenty of proportionate length and workable faces, but are broader in the middle than at their ends, a shape that will create ugly clefts in the wall's face when laid beside other, straighter stones. The sixth is mighty tempting, but its face is on the long side, not the end, and so very little of it will be gripped in the wall's heart. When things begin to loosen up, it'll be one of the first pieces to go. The last two have good length and bulk, but both have upper surfaces that angle down at the facing ends, and so they will not support the outer edges of any stones laid on top of them, soon threatening to spill them out. We call them *ski jumps*.

Pay What?

With commercial dealers, prices are generally fixed, but when you bargain

with a landowner, you'll have to work out something acceptable to both parties. We've typically paid about sixty dollars a ton for good weathered building stone when we have to pick it and transport it ourselves, but over one hundred dollars—sometimes well over—in cases where the loading and hauling were done by others. A ton of stone isn't very much. Twelve to fourteen one-cubic-foot blocks of granite will weigh close to two thousand pounds, an amount that if stacked together will make a solid unit six feet long, two feet wide, and two feet tall, with another one or two blocks riding on top. Think of something about the size of an average refrigerator. Other kinds of stone such as shale, schist, gneiss, sedimentary types, etc., don't weigh quite as much because they're not as dense, but this is a workable rule of thumb.

What's less predictable is the range of prices in your own area. We're in central New Hampshire, a section of the state that isn't heavily urbanized but isn't the boondocks, either. There's still some open farmland left, as well as many wooded areas that used to be farms (and are full of ruinous stone walls). People call it the "ruburbs" now—not quite suburbia just yet, but getting there. If I drive south into lower New Hampshire's heavily populated belts in the Manchester/Nashua corridor, into eastern Massachusetts, or farther, everything gets more expensive. If I drive north or northwest, toward the mountains or up into Vermont or inland Maine, things abate a little. You'll need to do some research in your own corner of the region to see what people are getting for things like loading, transport, and even the stone itself.

Stone can also be sold by the load instead of by weight. You can estimate the value of a load for purposes of negotiation by rough calculation of tonnage based on volume, then offer the seller a per-load figure. A typical one-ton truck can haul up to three tons of stone, an ordinary tri-axle (or ten-wheel dump truck) up to fifteen. Plain old half- or three-quarter-ton pickups start complaining if you put more than their designated load capacity into them, which makes them less efficient for moving larger quantities, though sometimes more convenient, especially for modest projects.

RECYCLING STONE

The practice of recycling old stones into new walls has its critics. Many New Englanders are anxious to see our traditional agricultural landscapes preserved wherever possible, and the old

walls, even in conditions of advanced deterioration, are integral to those landscapes. Some would like to see broad prohibitions enacted against the removal of antique walls, or believe that such prohibitions already exist (they don't). In fact, we lose a little more of the old network every day, to development, to roadwork, to logging and woodcutting operations, to theft. Natural causes—the toppling, sinking, and gradual burying of long-abandoned walls way out in the woods probably do more than any other single force to whittle away at what remains.

But we also save a little. Conservation easements, land trusts, local ordinances and individual preservation efforts have made a difference. So has the increased interest in building and restoring traditional stone structures on the parts of professionals and amateurs alike. If I take the stone from a half-collapsed old wall that will never be restored to build a new one or refresh a deserving antique, am I committing robbery or renewal? Reasonable people can disagree on this. But I, being not entirely unsentimental yet a Yankee still, find my mother's old adage persuasive. And I know that my predecessors here, who never hesitated to alter the landscape, recombine dismantled barns and houses, or move their church from one part of town to another as circumstances changed, would think my recycling as natural as rain.

If you hire a contractor to do your hauling, it's a good idea to locate someone who can also load the truck. A one-ton can be loaded by hand, but it's rugged work. Larger vehicles need to be loaded by machine, and unless your seller has a front-end or other kind of loader and is willing to help, you'll have to make your own arrangements. Be sure, however, to insist that the machine's bucket be filled by hand at the site before being hoisted into the truck. If you don't, you'll duplicate the discouraging experience I recounted near the beginning of this chapter, besides scarring up the stones more than you have to. As you become a more advanced builder, you'll most likely want to participate in the picking and loading of your supply, even if it's only to point out the beauties you want taken.

Trundling off into the hinterlands in pursuit of pretty wall stone can be challenging. The stone is out there, but so are poison ivy, yellow jackets, ticks full of Lyme disease, and some pretty impressive (though mostly non-venomous) snakes. Taking appropriate precautions, especially if you're not accustomed to being in the woods, is a must. So is having a good handle on the amount of stone you actually need. There's not much point in

offering yourself up as the next test case for mosquito-borne West Nile, Triple E, Zika, or whatever virus-of-the-month is current, any more than you have to. That's why it's helpful to know, before you start collecting the good old stuff, what the total volume of material in your project is and how much of it is going to show when it's completed.

Simple multiplication (height × length × width) will give you a rough idea of overall cubic footage. We generally try to exceed that by 20 percent or so in order to expand the range of choices as we build—it's less effort in the long run to haul away a few loads of extras than to struggle to use every stone as the supply becomes less and less cooperative during the job's later stages. But you can increase efficiency even more by following your calculation of total volume with another one for the volume of face stone only. If you're building a retaining wall, for instance, that is three feet high and fifty feet long with a battered back side that tapers from a three-foot base to a one-foot cap, the total volume of stone in the structure will be about three hundred cubic feet. Assuming that all the stone within a foot of the wall's single face is considered to be "showing," that means the volume of stone that has to be good looking is only about half the total volume of the structure. The rest can be anything at all—six- or eight-inch riprap, construction rubble, quarry tailings—anything as long as it's stone. The larger the project, the more of this invisible interior space you'll have, and the more you can save in money and aggravation when it comes to gathering material. Even a petite two-by-two-foot freestanding garden wall will absorb a fair amount of interior packing that doesn't have to be weathered or lovely.

The site of this reconstructed double-face needed no special preparation because a previous wall stood there for many years. One of its old, massive boulders was incorporated into the restoration.

Site Preparation

One of the great virtues of a dry-laid wall is its structural flexibility, which allows it to adjust to changing conditions on or in the ground where it sits. Some of these changes are seasonal, like the freeze/thaw cycles of winter and spring. Some

develop over the long term, such as expanding tree roots, erosion, uneven compression into the soil, or the steady push from settling fill behind retaining walls. Still others are incidental, like the tunneling of animals, earthquakes, or tree-falls that tear out root systems, leaving small craters.

Swiftly catastrophic events such as flash floods and blowdowns are one thing, but a well-built dry stone wall can adapt to slower changes in site conditions with remarkable elasticity. Whether partially heaved upward by frost or roots, or subsiding gently into a patch of softer soil, good walls are able to mold themselves to alterations in the topography of their footprints because the pressure-spreading configuration of their interwoven stones finds multiple ways of sustaining relative position among individuals even when the stones are slightly shifting. Mortared walls can't do this because their stones are trapped in a solid mass, a rigid unit that can only break, not flex. Comparing the two is like comparing plate armor and chain mail; one encases the body in an immobile shell, while the other flows with it as it moves.

The ability of a dry-laid wall to adapt itself to ground conditions over time is limited, however; sooner or later one too many adjustments will be made here and there, and the inevitable loosening that leads to breakdown will begin. But even within limits, a dry wall's flexibility makes site preparation much easier. This was well understood by New England's farmer-builders, who laid the vast majority of their work on untreated ground and simply allowed it to sink in—or not—as it saw fit. In areas where the subsoil was very soft or very wet, or in cases where the wall itself was to be exceptionally tight and fancy (and thus likely to display minor disturbances more prominently), they would occasionally install a stone-filled trench below the structure's footprint to minimize settling and to move water out from underneath the first course of wall stone in an effort to prevent frost damage or erosion. It's interesting to note that, as New England's vernacular stonework became more stylistically diverse, the nineteenth century's farm manuals and instructional pamphlets called more and more for trenched bases. Still, most ordinary builders didn't trouble to dig them. We can be fooled these days when we dismantle their work and find two or three rows of stone apparently interred under an old wall, well below the existing grade. But this is often only the result of a century and a half's worth of leaf-fall, which has built up fresh soil against the wall to the point where its lowest courses appear to have been placed in an excavation.

To Trench or Not to Trench

Deciding whether your wall should be trenched means answering these questions: How large is your project? How tall, how thick? Is it a freestanding piece or a retainer? Are you building on fresh ground or on the site of an older wall? If on fresh ground, what is the composition of the soil? If on an old site, what is the condition of the previous wall's base? Is the topography relatively flat, or are you building on a slope?

The larger a project, the more weight it's going to concentrate on its footprint. Most walls press themselves into the ground over time to some degree, but above two feet tall or so, that pressure begins to ratchet up considerably, especially if the wall is freestanding. Retaining walls tend to have thicker bases that are more resistant to sinking, but a four foot freestanding wall, with its proportionately narrower footprint, will drive itself down much faster. On soil that is soft, wet, sandy, or loamy, this process is accelerated as the soil compresses or even starts to squish out from under the base stones to escape. If this happens unevenly from section to section along the wall's length, vertical separations begin to develop at points where sections sinking at different rates meet. Mortared work is especially vulnerable to this kind of damage because of its rigidity, but dry walls will suffer it too if the difference is extreme enough. Trenching avoids this threat by equalizing the rate of settling along the wall's entire length. The wall may still sink a bit, but it will do so evenly, and less self-destructively. In cases where you're unsure if you should trench or not, remember that you can't go wrong by doing so, even if you don't really need to. And on new-construction sites where the ground has been churned up and disturbed, or is composed of fresh fill, pure loam, or (god forbid) sand, trenching is nearly always required.

Antrim, NH's 1862 cemetery wall is a masterpiece of rough-split boulders and slabs, fitted together with chips and chunks left over from their splitting.

On Virgin Ground

When we set out to build something of stone on ground that has never carried a wall, we begin by digging a test hole. Many times we find the topsoil turning to mixtures of gravel or compressed sand within a foot or two of the surface. In other places the dark brown loam on top rapidly cross-fades to lighter dirt filled with more small or medium-sized stones and less organic material. Dig a little further and we might find our shovel stopped cold against what we call hardpan, a cement-like concoction of dry clay, stones, and gravel, impenetrable to a mere spade, that must be broken up with a pick or iron bar before it can be shoveled at all.

If the digging is easy with a spade alone, and the wall to be built is substantial—two feet or more in height—we will excavate an eighteen-to-twenty-four-inch trench and fill it with riprap. Riprap is crushed granite, a most useful material in New England wall building. It's cheap and readily available, and it comes in varied sizes. We use the one-and-a-half-inch size for trench-work because it's small enough to pack itself down without being individually placed and because it can be raked smooth and flat to receive the first courses of wall stone. Trenches can be filled with fieldstone, too, if you don't want to go to the trouble of finding and buying

riprap, but you will most likely have to place the fieldstone carefully in the trench as tightly as possible so it won't shift around later on. Riprap works better.

The trench should be a few inches wider than the wall's footprint in order to prevent the exposed bottom edges of its lowest face stones from gouging into softer material beyond the sides of the trench and tilting outward and down as a result, thus threatening to spill succeeding courses out into space.

But if the digging is tough, the subsoil bony and stony or densely compressed, we simply skim off the soft surface turf or even build directly on the ground. The likelihood that a stone wall will distort itself by crushing its way into material that even a spade can't penetrate is extremely small.

On the Site of an Older Wall

Whether restoring an old wall that still stands or building a new one over the wreckage of a predecessor, site preparation is simplified because the ground is already compressed as much as it can be. In many cases, the base of the former wall is still in position even if the wall itself is fallen and scattered. The first step, then, is to clear away all the loose, superfluous stone and take a look at what the old wall was sitting on.

The issue is leveling. Large base stones under old walls tend to shift out of line over time. Any of these whose upper surfaces are now tilting to one side or the other will have to be reset so they once again offer level platforms for what is to come. It's also possible that you will encounter base stones that never presented anything like a flat surface, but rather the hump of a whale's back, higher in the middle than at its ends. These will have to be disinterred and either re-laid upside down, on edge, or discarded altogether if their shapes don't permit the creation of an even surface in any position. Integrity in reconstruction does not have to include slavish allegiance to the mistakes of previous builders. Finally, you may also find instances in which two base stones have been laid side by side to offer a valley (rather than a flat surface) into which a triangular or blade-shaped stone is meant to be dropped that will turn two peaks into a single platform. In general, if you can see a way to build solidly upon base stones as they are, it's best to leave them undisturbed.

When you remove a partially buried base stone, there'll be a hole. Fill it level to the grade with riprap or other small stones before you reset the base. If you only have to pry one end of it up to set it flat again, prop it in place with a stone or two after you've raised the lower end, then tightly

and carefully fill the space below with the same material. Make sure it's solidly supported before you start putting your hands underneath it.

In addition to leveling, site preparation on an old base means taking a look at the ways the outside ends of its face stones meet side to side. If the wall is very rough, or if it is a single-stack type, closely-fitted joints between face stones don't matter as much as they do for double-faced or fancier work. But sometimes the base stones of older work have more or less tapered ends, and when laid side by side they leave difficult triangular gaps right at the line of the face itself. This can make it difficult to place the second course over the joints between base stones—there's nothing there to hold it up. If you have pieces that are large and stable enough to bridge the gap, fine—you can always stuff a little chunk of cosmetic filler into the remaining space below after you've placed the bridge-stone. But if the gap is relatively wide, you'll have to fill it with something that has a bit more structural stability. This usually means finding an elongated pyramid-shaped stone—something like a miniature version of the TransAmerica building in San Francisco—with a face on its thick end, then laying it in between the ends of the old base stones, tip in, to form a more continuous line of support. You may want to excavate the material underneath this compensatory piece and fill the hole with riprap to keep it from driving too deeply into the soil between the larger base stones.

The jumbled back side of this cemetery wall in Antrim, NH, bears no resemblance to the precisely fitted public face out in front.

On A Slope

Most of the guidelines for site preparation apply to walls being built on slopes the same way they do for those on flatter ground, as long as the wall runs straight up the grade. If the wall traverses the slope to any degree, however, much greater care is needed. Slopes encourage stones to slide and sink, and a wall that runs across the face of slanting ground will disintegrate downhill inexorably as it settles and ages. Even a wall that stands on flat space at the top of a falling grade, if it's too near the edge, will find the slope and begin to spill over and down in time.

A wall that is built straight up a grade acts as its own anchor because the tendency of stones to slip downhill is arrested by the mass of the wall directly below. If the wall ends at or near the bottom of the hill rather than continuing on, you might find it useful to bulk up that end a little more than you would otherwise in order to make sure it can't be pushed over by the inevitable pressure from above.

But for a wall that crosses a slope laterally, even a little, special preparation is essential. This means excavating into the hill to create a deep, flat shelf for the entire wall so that none of it is sitting on tilted ground. The cut should be six inches to a foot wider than the wall itself so that you can step the whole thing back from the downhill edge of the excavation by that amount. It's even advisable to dig the cut so that its uphill side is a little lower than its front edge. Then the wall will be invited to settle into the hill in place rather than set out on a migratory slide to destruction.

One more thing. It's advisable to build a somewhat thicker wall than you might otherwise when it sits on such a shelf. This is because its lower courses are going to become a partial retaining structure up against the back side of the excavation. The steeper the slope and the deeper the cut, the higher its back side will be. As both wall and excavation settle themselves over time, the exposed soil of the excavation's vertical uphill side will begin to push against the wall, adding its pressure to the gravity-induced tendency for the wall to slip downhill. A thicker wall will resist this added pressure more effectively.

CHAPTER 3

An old single-stack wall restored to its original height.

The Fundamentals of Dry-Laid Construction

The mantra of dry-laid wall building is the famous "one over two, two over one" rule, a commandment best taken as symbolic, not literal. Strict adherence to this ancient law is only possible if you're working with brick or concrete block, or with

stones essentially identical to one another in size and thickness. Random New England fieldstone neither conforms nor aspires to this condition, so, in practice, your “one” may end up perching on two … or five, or your “two” on one … or eight.

The point of the rule is to integrate each stone into the larger mass of wall by creating multiple physical dependencies for it rather than only one. Another way of putting it is to say all stones should be laid to touch as many others as possible. This distributes weight and pressure in many directions across and within the project, giving it both structural unity and flexibility. Its most visible consequence is the absence of *running joints*, uninterrupted vertical seams between several layers of stones that have the effect of separating the wall into disconnected sections that will deteriorate much faster over time because they are not woven together and cannot help support one another.

Avoiding running joints by “breaking” them with stones laid over the cracks between others in the previous course is only half the battle, however. There is another kind of running joint, an invisible one, that threatens to do even more damage than those between sections of a wall’s face. This is the “joint” between the face as a whole and the interior bulk of the wall. If the individual face stones are too much alike in length, so that they penetrate the wall to about the same depth over and over, they will in effect become a separate structure from the wall’s interior and be subject to rapid deterioration as whole sections peel away from the bulk of

the wall over time. Wallers in the UK alleviate this difficulty with the use of *through stones*, pieces long enough to span the full width of the structure in order to tie its outer "skins" to the rubble in between and to each other. But New England builders often find that our rebellious stone supply doesn't offer nearly the necessary number of stones both long enough and flat enough to be used this way. We compensate for this deficiency twice over: by placing face stones so that the depth of their penetration into the mass is varied and uneven, and by building up interiors with close individual placement rather than by dumping or throwing large amounts of smaller material into the walls' centers as loose filler. In double-faced work, it is often possible to create the next best thing to a through stone by alternating long builders from side to side of the structure so that their tails pass or even touch one another within the wall's center.

Because so much of New England's fieldstone is lumpy and bulky rather than flattened, broken, or consistently angular, the construction of walls seldom proceeds with predictable, course-by-course orderliness. Instead, it goes up in a jagged, irregularly crenellated fashion, constantly creating new and oddly shaped gaps and spaces as each stone is added. With every face stone she lays, then, a builder must assess three things in order to determine whether the placement is a good one. First, that it sits solidly in its spot, well supported by the stone or stones below and unable to rock or shift when touched. Second, that it offers a stable, preferably level platform for the stones yet to come, *or* that it can be combined with an adjacent stone in the same course to create such a platform. Third, that its placement breaks a joint or joints in the face course below, *and* that its depth in the mass of wall behind either breaks the invisible joint between face and interior, *or*, if it is too shallow to do so, sits in close proximity to one that does. This sounds more complicated in description than it actually is: It's one of those things that becomes instinctive relatively early in the learning process.

Large vs. Small

Some builders try to grade their stone out once it arrives at the job site, separating large from small, flat from round, squares and rectangles from more random shapes. At least one UK instruction book I've seen offers a handy diagram in which the entire supply for a project is mustered in parade-ground rows, from the largest and bulkiest pieces for the base, through ranks of gradually decreasing size that comprise the meat of the structure to the rear guard of flat plates that will form the project's cap, all lined up in the order in which each will be used. Reserve regiments of

smaller rubble for interior packing stand respectfully off to the side. Apart from affectionate amusement at the lengths to which the British love of hierarchy will go, one wonders which of these tasks takes longer to accomplish; ranking the stone or actually building the wall.

The assumption here is that large stones go into the base, and smaller ones to the wall's body and its cap. But that is not what we see in much of traditional New England stonework, which often features a mix of sizes throughout the structure and is just as likely to show some of its largest pieces four or five feet off the ground as in its base course. Because of this, we'll generally make some effort to spread our supply out enough to be able to see what's there, but won't bother formally separating it by type.

Supplies of stone tended to be hauled piecemeal to eighteenth- and nineteenth-century building sites, and so were seldom present all at once to be sorted. It's likely, too, that the farmer-builders understood that the greater stabilizing effect of bigger, heavier stones is just as useful up high as down low and possibly even more so, since the crushing weight of a hefty chunk placed across groups of smaller stones clamps them in position with a structural unity that makes it much harder for them to shift about. The British habit of creating *through-bands*, continuous lines of through stones about three quarters of the way up a wall, does the same thing, especially when the bands themselves are loaded with the wall's upper courses and its cap. New England builders, who usually have many more mini-boulders than through stones on hand, place their stabilizing larger stones at opportune spots all through the wall rather than in a lateral line at a single level. The effect is identical. The New England tactic of finishing walls built largely of manageable basketball and head-sized stones with a running cap of eight- to twelve-inch rough-split granite slabs is another version of the same concept.

Laying Out

When we begin, then, we don't lay out base courses made exclusively of the largest stones in the run. Instead, we spot some of them at irregular intervals all along the section, then fill in the line between with others of medium size (see photo on page 44). The importance of a base stone isn't so much its relative bulk as the quality of contact it makes with the ground or stone-filled trench on which it sits. This means setting the flattest, widest side of the stone, the side that will resist being pressed downward most effectively, on the ground. It also means that certain kinds of shapes don't belong in the base. Stones that are too round, too shallow, too narrow, or too small will be driven into the subsoil more quickly than wider pieces, and that may cause their support for the mass of wall above to become unreliable. This is particularly important out at the exposed edges of the base, where a stone that is too shallow often becomes the culprit behind a later blowout because it sank faster and more deeply than the stones beside it. Even the smaller base stones, then, must be long enough to run in under the wall to a depth of a third to half its width. This will help equalize their rate of settling as well as make sure they do not tip out and down as the wall begins to age and loosen.

Marking out the footprint of the wall before laying its base tells you where to place its first stones. We seldom do more than run a simple string between stakes, about six inches off the ground. Some builders create elaborate wooden frames, placed at each end of the section, that allow a whole series of string lines to be attached that define not only the perimeter of the wall's footprint but also its sides, height, and degree of slope, or *batter*, if it's built to narrow as it rises. This technique can be useful for very precise, squared-off work, but it isn't really necessary for the rough New England style. Besides, too many strings get in the way. You're more likely to produce the old look if you set out your string line to establish the base course only, then do everything else by eye until you get to the cap. The small anomalies that result from this more casual approach actually will add to the authenticity of your final result, as long as they're not too radical. Keep stepping back as you go to look at the developing plane of the piece as whole, to make sure you're not building in too many unattractive bubbles and waves or slipping too far off the vertical in certain spots. Be sure to set each outside stone in the base as close to the string as possible without touching it. You'll ruin your nice straight line if you let the stones start pushing on it.

For freestanding walls that aren't single-stacks, and for retaining walls, the width you lay out should be a function of the finished height you're shooting for. Freestanding double-faced walls should be no narrower than

about three quarters of their intended height, so that a six-foot wall needs a forty-eight-inch footprint, or a three-footer one that's at least twenty-four inches. Retaining walls need more: they should begin with a footprint at least as wide as the wall will be high, especially if they are four feet tall or less.

Battered or Straight?

Battering is the practice of laying successive courses of stone slightly further in each time, so that the outside faces slant toward the inside and the wall as a whole becomes narrower as it rises. Not a few builders feel this technique produces a sounder structure in the long run, and it's a dominant tradition in many places, including Great Britain.

Not, however, in New England. For reasons that aren't entirely clear, we have tended to favor the vertical in both freestanding and retaining walls. We have a fair number of half-and-halfs—walls that are straight up on one side and battered on the other—but fully battered freestanding walls are not the norm in much of the region. It may be because the design uses less stone, or because the more generous interior space of a vertical wall allows us to stow away more of those terrible shapes. The British also tend to lean their single-faced walls up against the banks they are built to "retain," and to build them much thinner than we do, without the backside mass to do the real work of stabilizing the higher grade. Maybe we just didn't know any batter.

History offers numerous examples of successful construction of vertical faces, even in walls that are very tall, and even in places where battering is the common practice. So we have come to regard it as largely an aesthetic choice, something to do if that's what you prefer to see, but not a technique that's structurally significant enough to think superior. Good building seems to produce long-lasting walls whether they're straight up or aslant.

Laying Up

When the base courses of a section are complete, back them up immediately with the first layers of interior packing. If the wall is freestanding, fill in between the lines all the way across. If it's a retainer, fill to the back of the section. Place these stones carefully, leaving as little space as possible. Tuck chips and shards under and around the tails of the

outside base stones—you're trying to create the most solidly immoveable mass you can. Don't hesitate to use larger stones inside the wall in any spot—their greater stability is helpful no matter where they are in the project. This is your opportunity, too, to begin to employ some of the rounded and lumpy material that's unsuitable for the face.

If the wall is double-faced, lay up both faces at once so the structure as a whole rises more or less steadily across its entire width. Fill in the center

as you see the valley between lines of face stones deepen, but never any higher than the lowest outside stone. You want to maintain the most even and level platform you can at all times, so that your range of choices for placement remains a broad one. In the faces themselves, alternate shallow stones with deep ones to break up the interior joint between face and body. Try to place your longest face stones in rough pairs, one to a side, so their tails pass one another or even touch in the wall's center. Try to pack interior stones as tightly as possible around these tails, but avoid using too much very small material. The temptation to pour quantities of golf-ball–sized rubble, pea-stone, or even gravel into a wall must be resisted. They will migrate relentlessly between larger stones and actually contribute to deterioration over the long term by disrupting the web of structural relationships your careful placement has so laboriously achieved.

The single face of a retaining wall makes its construction less complex than a double-face, but no less methodical. An old-fashioned retaining wall is built as a reverse dam, a right triangle with its vertical side out and its ragged hypotenuse facing the higher bank. This means the preponderant bulk of your material is going to be out of sight, hidden away in that great triangular mass behind the face. It is still important, however, to place every stone in it as tightly as you can. Dumping or throwing stone into the breach will leave large amounts of space, and when the stones back there begin to reorder themselves over the years, they will leave sinkholes and collapsed sections in the bank behind the wall, and their settling will threaten to push individual stones or whole groups out of the face in front.

Loaves and Balls

Robert Frost's "Mending Wall," perhaps the signature poem of New England walling, uses these terms to characterize the fallen stones that he and his taciturn neighbor spend a day replacing on the old single-stack wall that separated their properties in East Derry, New Hampshire. "We have to use a spell to make them balance," Frost observes. Spells may indeed be the only choice when it comes to securely laying some of the more maddeningly spherical builders in our supply, especially in a single-stack, which has no mass to grip or contain its least promising stones. In double-faced or retaining walls, however, there are alternative methods for making sure these delinquents stay put—for a while, anyway.

An excessively rounded stone, whether it's roughly circular or loaf-shaped, doesn't sit very well on a flattened surface. It needs a spot that conforms to its curving sides. One way to do this is to create a V- or U-shaped perch with the stones that flank it. Another is to back-shim it with

blade-like shards that function just like the triangular cleats workers put behind the wheels of their trucks when they park. A great many stones that won't behave on a level plane can find stability when set into a space that's been altered to receive them. Back-shimming is also an excellent way to raise the tails of other kinds of face stones so that their upper surfaces can be leveled for the next course. When you do this, though, make sure that the shims themselves are held in place by other interior stones, so that they will not slip away from their responsibilities as the wall ages.

Using shims to stabilize larger stones only works on the inside of the wall. You may be tempted to compensate for various flaws in some stones by shimming out front, in the wall's face. This is called *chinking*, and while it occasionally is unavoidable, it's not a sound practice. Chinkers, because they are generally too small and not well integrated in the larger structure of the wall, are usually the first stones to pop out as it loosens up in time. The best way to use them, when you must, is as fillers for unsightly gaps you've left between larger stones in the face. Still, they need to be thought of as Band-Aids—they are not reliable as compensation for loose fitting.

Triangular cleats under the sides and back end (not visible) of this rounded stone create a stable bed for it.

Loaves and balls can also be stabilized in the face of a wall by *trapping*. This is the technique of placing sharp-edged stones on either side or on top of a rounded stone so that they slightly overlap the edges of its face, thus

creating an opening in the wall a little too narrow for the rounded one to squeeze through. Trapping can also be used to secure stones that are too shallow to be properly gripped in the mass behind, even if they're not rounded themselves.

Badly shaped builders need all the assistance they can get in order to hold their positions. When you have a choice, then, it's helpful to lay them with their heavier or thicker ends or sides in toward the center of the wall rather than out at the face. The closer their weight is to that outer edge, the more likely they are to topple forward into space, eventually. Setting their centers of gravity as deeply inside the structure as possible means they have a much better chance of remaining anchored in the mass during settling, rather than being slowly expelled. In general, extra care should always be taken to pack in the smoother, rounded stones as tightly as you can, whether they're featured in the face or not, so that their greater tendency to roll and shift about will be further arrested. It helps, too, if the worst of your loaves and balls find spots for themselves in the immediate vicinity of some of your best builders and face stones, those large, angular or flattened platoon leaders that create zones of stability for all their neighbors wherever they're placed.

Just below the white marker-stone, a pear-shaped builder is trapped between two broken chunks of granite, which leave an opening too narrow for the wide end of the pear to squeeze through.

If all else fails, you can always resort to Frost's spell: "Stay where you

are until our backs are turned!" He does not report on its ultimate effectiveness.

The Face in the Window

It is in the wall's face, its visible surface, that the distinction between the traditional New England look and generic contemporary stonemasonry is most apparent. Modern fancy work looks for the flattest possible plane and the tightest, most orderly pattern it can find. It requires individual stones not only to present sheared or flattened faces without bumps, swellings, or protuberances, but also to align those faces with the plane of the wall as a whole.

The faces of stones in work like this must meet one another laterally right there at the surface, leaving no indentations or little valleys between stones. If you held a sheet of plywood up against such a face, every stone would touch it, all the way across. Where straight lines are present along the circumferences of individual stones, they must be laid to reflect the baseline of the wall itself, or be perpendicular to that line, if at all possible. Stones with angled or rounded lines along their edges should be absorbed into the dominant horizontal/vertical pattern of seams as efficiently as can be, so that the wall maintains its overall grid-like appearance.

This kind of stonework strongly expresses two values common to most building trades: control of materials and mastery of techniques. But it does so without clear visual reference to the necessities that caused the wall to be built in the first place. In this respect it is self-conscious, a demonstration of excellence for its own sake. Whatever connection it has to the original condition, or the larger purposes, of the landscape it is part of seems almost secondary to this demonstration. Because its stones were so obviously selected and collected in order to make the wall look a certain way, it's harder to imagine them being plucked and hauled as is out of the spaces they now enclose. People driving by say, "Wow, look at that *wall*!" not "Wow, look at that *place*!" The wall seems imposed on the land rather than derived from it. A separation has developed between its context and its style, like a historical running joint.

The old way of building substitutes intuition for calculation, improvisation for precise selection. In single-stack work, it ignores faces altogether, concentrating solely on integrity of structure. In double-faced or retaining work, it conceives of the wall's face as a space between two planes, not a single surface. Though it seeks consistency of appearance as a matter of craftsmanship, the leeway it allows in both its patterns and its

fitting is considerably more liberal than fussier contemporary styles permit.

Old-fashioned storm windows are made of two sashes laid over each other; two large panes of glass separated by air. If you think of your wall's face this way, the outermost points of the wall's face stones—their *snouts*—collectively define the outside pane. The inner one sits where the shoulders of those face stones meet one another, on average, almost within the wall itself. Establishing the depth of the distance in between these panes tells you what's going to be permissible as a "face" on any given stone. Though most of the rules for correct selection of builders remain in force, all kinds of surface configurations are now acceptable on their visible ends. Above all, it means they no longer have to be flat. As long as their snouts and the shoulders of their visible circumferences fall somewhere within that space between panes, they can be rounded, broken at multiple angles, concave, pointed, or unevenly bumpy. Needless to say, the technique automatically renders a considerable percentage of your stone supply far more useful than it might have been otherwise.

This relatively fancy wall's narrow plane-window gives a smooth, orderly aspect to the structure.

A deeper plane-window makes the wall look rougher, older, and less self-consciously artful.

The depth you assign to the window also determines the degree of roughness in your wall's finished face. Here are two examples, one with a relatively shallow window and another whose window is deeper.

In addition to allowing the use of a greater variety of shapes in a wall's face, the concept of the plane-window also helps produce consistency of appearance from end to end in the structure. It can even alter the way you perceive its individual stones. Standing at some distance away from a wall that's built this way, you'll often notice that its face stones begin to seem flatter than they really are.

The Mystery of the Curve

Craft guilds of the medieval era called the details of their occupations "mysteries," a term they derived from religious language. This is why the elaborate theatrical performances Guild members staged on Catholic festival days—always with sacred themes—are known as Mystery Plays. The designation does not denote unfathomable religious arcana, however, but rather the professional status of the performers, whose membership in the Guilds entitled them to privileged information about their vocations. In this usage, "mystery" means something that certain people know, not

something that baffles them (though it may certainly baffle others).

Stone wall builders are privy to a mystery about walls that curve. This mystery explains why a convex bend is harder to build than a concave one, why a round pillar is more challenging than one that's square, why stone-lined wells are among the most durable of all dry-laid structures, and why an arch can stand.

The mystery of the curve is a consequence of the expanding/contracting nature of concentric rings. Imagine a central point with a circle drawn around it. Now imagine another circle drawn around the first, some distance away. The line that forms the second circle must be quite a bit longer than the line that forms the first, because concentric circles will expand infinitely the further away from the center they are.

Now imagine that your two circles are actually the two faces of a double-faced, donut-shaped stone wall. It's obvious that the outside face of this structure, having so much more lateral space to fill, will require more stone than the inside face. This will be true of any circular stone structure you build, no matter its size. Yet the two circumferential lines, of very different lengths, are joined, back to back, as parts of the same wall. How do you reconcile the difference in the act of building?

The answer is in the selection and placement of the face stones themselves. In straight-line work, individual face stones can be largely the same thickness from end to end. But in circles or curves, they must be tapered, with one end clearly wider or fatter than the other. On the outside face, those wider ends are laid to show, and on the inside, the narrow ends predominate. While it's not necessary that every stone in both faces have a fat and a thin end, the majority of them should be shaped this way in order to make up the lateral discrepancy between the long side and the short side of the wall. This principle applies equally whether the wall forms a complete circle or only a partial one—like a curve.

It also presents certain challenges. For one thing, it's not generally a good idea to lay radically tapering face stones with their wide ends showing: it's much easier for them to be squeezed out as the wall settles. That's why it's important to use lots of *gradually* tapering faces for an outside curve rather than just a few with very broad faces and tiny, pointy tails. Curves tempt you to use shallower stones than you'd like, too, because it can be difficult to locate many builders that have the requisite degree of taper but also enough length to get a purchase on the wall's interior. If you can, it's helpful to select roughly-surfaced stones for these positions. They'll grip their neighbors more firmly than smooth-surfaced ones. Even so, the face of an outside curve is inherently more unstable than a straight line or an inside curve, and its instability increases the sharper the curve gets. One of the toughest configurations to construct is a

freestanding complete circle (or segment thereof) that is only three or four feet (or less) in diameter. That curve is just too tight to build well.

The geometry of an inside curve is considerably more friendly to builders. The extra space is back inside the wall now, not in its face, so tapered builders must show their narrow ends and let their wider tails help fill up the expanding interior. In truth, it's not necessary to use tapered face stones at all on an inside curve, because you can always fill the developing gaps between their tails with shards or riprap or other packing material. But it's wise to use them if you have them, because they allow you to strengthen your wall by employing the principle of the arch.

The Carr Bridge, in Hillsborough, NH, is a beautiful example of mid-nineteenth century dry-laid arch work.

Arches can stand—and bear enormous loads—because their individual stones are precisely cut to form a continuous inside curve from which none can escape. Although the difference between their wide and narrow ends is often just an inch or two, it's more than enough to keep them in place because the opening they occupy between the stones that flank them in the arch's vault is only just large enough to admit that narrow end. They simply can't squeeze out. An inside curve in a wall, then, is just a rough arch laid on its side. It may not receive quite as much gravitational assistance as upright arches do, but the stabilizing effect is the same.

Perhaps the ultimate inside curve in New England wall building, though, is the stone-lined well. These fully circular retaining walls, built like narrow tubes straight down into the ground, are among the longest lasting dry-stone creations of all. With a construction technique that prevents individual stones from escaping, and a self-reinforcing circularity that prevents the larger structure from loosening up, the old wells testify as strongly as anything can to the practical ingenuity that built our historic farming infrastructure.

Alternating longer and shorter stones on both corners of a butt end help hold it together.

Ends and Caps

Finishing off the ends of your wall, and capping its top, can be accomplished in numerous ways. Some of them reflect personal preference and others the nature of your stone supply. Some respond to topography and some to the style of the wall itself. Some are suggested by function, and some by convenience. There's considerable leeway in your choice of end and cap styles. Almost all of them have been used in various kinds of New England stonework over the years, so it's hard to go too wrong. Tradition will support almost any choice you make, but each has particular requirements and degrees of difficulty, and these often become decisive as you contemplate your options.

BUTT ENDS

Terminating a wall at full height with an exposed butt end is a common way of finishing when the wall is freestanding, when it forms one side of a wide opening that will not be gated (like a driveway), or when the wall is relatively short and relatively low, such as those that are often found in formal gardens or other landscaping schemes.

They can be challenging to build. A butt end is a pair of corners which must be soundly anchored not only to the wall itself but to each other. They're more vulnerable to eventual distortion and collapse than other parts of the wall because they are exposed on three sides with nothing to back them up. The margins for error in construction are very small. They also require quantities of builders with ninety-degree angles to them, which are not always easy to come by.

Butt ends magnify the necessity of making sure your wall is wide enough to sustain its height. In general, any freestanding dry-laid wall should be at least three quarters as wide as it is tall, so that a four foot high wall will be somewhere in the neighborhood of three feet wide. This gives you enough room to allow the alternate weaving of corner stones, and the in-between face stones that connect them, over one another in offset positions, so that vertical separations through several courses are less likely to develop. Placing one or more through stones across the face of the butt is certainly the best way to do this, but when these are not available, you can cross-hatch the corner stones roughly over one another by placing their long sides first down along the wall's length, then across the butt end, by turns, with each course. Always work from the corners in, setting them in pairs and then filling in the sides and end space (if there is one) to level for the next set. The corner stones themselves should offer solid, flat support all the way out to their points; even a slight cutaway or ski jump there will weaken the structure significantly.

BOULDER ENDS

A simpler way to terminate freestanding walls is by placing a large boulder at your end point, then building the wall right up against it. This works well in less formal settings, when the boulder is already in place and the wall is built to come to it, or when you have a particularly good-looking monster you want to feature.

POSTS

Posts of stone or wood give a more finished look to the end of a wall. They're helpful when used at an opening where a gate will be hung, or if you want to protect the end of a wall from passing traffic. It's best not to build right up to a post, however, because of the possibility that the wall will settle against it and begin to push it over. This means you'll have to create a butt end a few inches back from the post. Keeping the post and the wall separated will make any future repairs or adjustments to either one much easier, besides being a very traditional configuration.

Proper setting of posts, by the way, is one of those applied manual arts that, like wall building, lost its place in the body of ordinary practical knowledge once most of us stopped living on farms. Here's a quick primer: Dig a nice, straight hole with clean sides, about a third as deep as your post is long and at least twice its girth. Stone posts need to go a little deeper, especially if they're going to show five feet or more above ground —a ten-foot granite post needs to be set forty to forty-eight inches below grade, for instance. Set the post in the hole and plumb it (hold it straight up and down). Pack some stones tightly around its base at the bottom of the hole, then alternate layers of dirt and other stones as you fill in around the sides. Stomp or tamp down this fill layer by layer as you go, making sure the post doesn't drift away from plumb during the process.

Running the wall right up against a large boulder is the simplest way to give it a solid termination point.

Posted ends give walls an elegant formality.

FADES

Fading a freestanding wall gradually downward until it disappears into the turf is a technique we don't see very much in older work, but it has found some acceptance in modern landscaping, particularly with walls that aren't more than two feet high or so. You can set a string to guide the wall's graduating descent, beginning at the point where it breaks from the sustained height of the main structure. This is not an especially traditional look, but it can be useful in some situations. Fading works much better, however, when it develops from the bottom of the wall rather than the top. With any walls that run into a higher bank, or terminate at the base of a slope, just hold the level of the wall's cap as your base begins to rise, and let the diminishing wall fade away as that height runs out of space at the end. With retaining walls, this really amounts to a kind of terracing, a deeply traditional form if you happen to live in China, Peru, or Southeast Asia. New England farmers didn't embrace the technique very much, even though more than a few of them lived on exceptionally vertical acreage; their main interest was in pasturing for sheep, and most of them didn't live on those hilltop farms long enough to fully develop the land for food production. I suspect we may see a lot more terracing in years to come, as the region's new generations of small-scale, green industry producers discover what a good trick it is.

PILLARS

As stonework became more decorative and less practical in the second half of the nineteenth century, portal pillars began to appear at the entrances to country estates and some particularly well-to-do farms. You can still see the remnants of some of the old ones in places like Wolfeboro, New Hampshire; Woodstock, Vermont; the Berkshire region of western Massachusetts; and many other New England places where old farms were transformed into summer retreats by affluent city-dwellers. Often used as end-features to road or drive-side walls, they add a touch of grandness—or, on occasion, grandiosity—to their country settings. They are by far the most formal way to terminate a wall.

Contemporary use of pillars has made them a little shorter than they once were, a little more modest in scale. Typically they're only twelve to eighteen inches taller than the wall itself. They are usually square; round ones are possible, but they are much more difficult to build (see above) and often wider than the wall in order to expand the space within them for stability's sake. The same complexities that make butt ends a challenge to builders are present here as well, though doubled because of a pillar's four corners.

When you're laying out a wall that will end with a pillar, stake the bounds of the pillar's footprint at the same time as those of the wall's and build them up simultaneously, so they will be structurally united. If the

pillar is going to exceed four feet or so in height, you should probably put a riprap base underneath it, even if the wall itself doesn't have one. Taller pillars concentrate a lot of weight on a small area, and nothing looks more disheveled than a pillar that's leaning over or pulling itself apart because of uneven settling.

CAPPING AND COPING

Many, maybe most, of the old New England agricultural walls were not "capped" in the sense that special types of stone or distinct configurations were used to finish off their tops. Single-stacks might be augmented with poles or rails laid over the stone lengthwise or supported by other poles set to straddle the wall in pairs like an avenue of crossed swords. Thicker, double-faced walls, part of whose function was to contain quantities of small stones or field-picked pebbles, might be simply rounded over. Where large amounts of relatively flat stone were available in the form of broken pieces of ledge or outcroppings from which heavy shards could be split away, walls might be finished with rows of sizeable chunks that would clamp down the smaller stones in the body of the wall. Others were built to their intended heights, then allowed to remain more or less uneven.

As stonework became more specialized and elaborate, capping also evolved. An improved method of splitting made the production of large, flat slabs easier and more accurate after 1830, and these began to appear as capstones on numerous walls, especially in civic projects like cemeteries and town pounds for stray livestock, but also along the tops of ordinary freestanding and retaining walls, and especially on foundations. After mortar was improved by the addition of Portland cement in the late nineteenth century, builders began to create solid, continuous caps for some stone walls by mortaring all the top stones together but leaving the rest of the structure dry. This was often done in places where the walls were relatively low and the threat of dislodgement of loose stones by human traffic was high.

The choice of a capping style for your project should be influenced by four things: aesthetic preference, the general nature of your stone supply, the function of the wall itself, and the wall's overall size. Capping—or the lack thereof—has a big effect on the visual impact of the structure, so whatever you do should be consistent from end to end. The top line of a wall always adds a defining touch to its presence in the landscape, whether in relation to the general topography of its area or to features nearby, such as buildings, flower beds, or other walls. Awareness of the interplay of these kinds of elements, and of the big picture generally, can help you decide what sort of cap will work best.

A low garden wall with a simple pieced cap mostly laid with flat plates and shards set aside during building.

As nineteenth-century farming was mechanized and fields grew larger, stone walls became more carefully shaped and selectively composed.

If your stone supply has a healthy helping of flattened shapes in it, you can set aside a pile of these for use in the cap rather than waste them in the body of the wall. Even if there aren't enough of them to entirely cover the top surface of the finished piece, they'll contribute significantly to its appearance of flatness if they're spotted across it at regular intervals. If there are few or none, however, you'll have to make a decision. Pallets of flat stones for capping can be had at most stone yards, or you may be able to locate a source for them elsewhere. They likely won't match the stone in the rest of the wall very well, but if the discrepancy is acceptable they can save considerable fussing. If you'd rather fuss than pay, you can get by without them. Stone walls do not have to be capped with flat stones to look like they have flat caps, especially at a distance.

The next thing to consider is the wall's job. All stone walls have a function of one kind or another, whether it's to separate a pasture from the woods or your lawn from the street. A tough old single stack at the end of a field doesn't need much of anything fancier than just a consistent line along its top that's free of obvious gaps, but a delicate little retaining wall in the backyard garden calls for something a bit more fastidious.

Finally, there's the matter of overall size. Taller, thicker walls, with their greater bulk and stronger presence in the landscape, aren't as dependent on their caps for either visual impact or structural longevity. Their heavier mass ensures there will be plenty of pressure coming from above to help keep the lower courses of the wall locked in place, while the wall's face, so much larger proportionately than its cap, draws the eye away from the upper surface. Walls taller than forty inches or so, whether freestanding or retaining, can succeed with any type of cap—unless there's a chance they will be called on to bear human traffic, in which case their capstones should be heavy enough to resist moving under foot.

Shorter walls are a different story. Without the hundreds of pounds per square foot that a forty-eight-inch pile of stone can press onto it, a lower decorative wall of, say, twenty-eight inches or less is far more likely to loosen up and start coming apart, and to do it sooner than heavier structures. Retaining walls this diminutive are especially vulnerable because of the push from settling fill they must hold back on their high sides. Their convenient height also makes them attractive as sitting spots unless you shield them with flower beds or other obstructions. Whether they wind up serving as benches or not, however, they will last longer and remain in better condition if they are capped off with the thickest, flattest stones you can find, or even with long slabs if they're available. Take a look at some of the antique cemetery walls you pass by in your travels around the countryside to see how well this technique can work.

As you approach the capping stage, build the entire wall up to within a foot or less of its intended stopping point so that you construct the cap all

at once rather than in sections as you did the body of the structure. If the stones you're using in the wall's upper reaches are fairly large, you may want to leave more than a foot of working space—it's easier to adjust individual capstones up rather than down because the latter may obligate you to remove pieces you've already placed.

Then set a new string from end to end. This can be run between two stakes at either end of the project, right over the middle of the wall, about an inch above the planned surface of the cap. As with the base stones you laid out to your first string-line, don't allow the developing cap to touch this one, either. If the wall curves, you can set additional stakes along its line to catch the string in positions where it will still be over the wall instead of out in space between the ends. This will mean your string zigzags back and forth a little, so you'll need extra care setting it to make sure its overall line is a level one. Keep sighting it regularly from different directions, or line it up by eye with something you know is level, like the clapboard line of a nearby building, if possible.

If the wall is double-sided and you want to be extra fussy, you can set two lines instead of one, but out at the edges of the cap instead of over the middle. This will keep you from producing little waves in the finished surface where individual stones or small groups of them wander off the horizontal plane you're trying to establish. Some kinds of walls don't mind the little anomalies that appear when you let your eyes be the only guide, but others do. This is entirely an aesthetic decision.

Variations in the kinds of stones you're using to create a cap call for slightly different installation methods. If your cap is composed of the same random supply that makes up the body of the wall, begin on the outside edges, as you would for any other layer of builders and fillers. Sight across the top of the wall frequently to make sure the upper surfaces of those outside builders don't poke up above the level set by your string. Avoid using too many small, hence less stable, pieces out on the edge—there won't be anything holding them down from above as there is in the lower parts of the structure. Be careful with side-to-side placement; if you leave awkward spaces between individual stones you may find it more difficult to fill them than you did down below, and the gaps will interrupt the continuous line you're trying to create. Once you've established the containment boundaries those outside cappers provide, you can fill in the middle space with … really, anything, as long as it is as tightly placed as you can manage and maintains the same distance between itself and the string all the way along. A wall's cap can be made of stones like softballs and still look as flat as an interstate if it's tightly packed and consistent enough.

The generous width of this roadside wall has absorbed large amounts of rounded rubble from nearby plowed fields.

If you have a generous supply of flat, plate-like material, whether varied in size and thickness or all alike, you can create a cap that's more like a tabletop than the cobblestone street that a random cap resembles. In this case it's often helpful to place capstones from the middle outward rather than from the edges in. When everything is flat, the outside lines of the cap aren't as tricky to define as they are with random material, so establishing a consistent distance from the string is made a little easier by beginning in the center.

Large supplies of flattened, broken stone also allow the use of a cap style known as *coping*. This is the method of capping with rows of flat stones set on edge, like a shelf of books, all along the top of a wall. It can be done in single or multiple layers set right over one another, and it's a great way to extend the height of a wall using less stone than a flat-laid cap would require. Coping is traditional in the British Isles, and while there are sections of New England, including parts of Vermont and some southern areas of Connecticut and Rhode Island, where there's more than enough fractured shale and slate to use the technique, New England builders seem not to have embraced it in any widespread way. Perhaps we were never all that interested in adopting methods that save on stone, having if anything an overabundance of it to cope with in the first place.

Situational Placement

This little piece of wall is an inside curve with faded ends. It's built of a typical mix of stones, some rounded over and irregular, some flattened or squared off, and others sharply broken or shattered into jaggedness. Larger and smaller pieces are used throughout the structure.

This wall is built *uncoursed*, which means its component stones aren't arranged in distinct rows, but rather placed individually according to the way their shapes match up with spaces left by the stones below. Since there's no consistency to their shapes, each new group of stones creates a different set of requirements—of "situations"—for the placement of the next group.

Learning to recognize correspondences between the solid dimensions of individual stones and the empty spaces left by preceding placements is only part of the job, however. It's also important to be mindful with each placement you make of the spaces that you are leaving for the stones yet to come. On top of this, the essential task of trying to lay as many stones as possible over the joints between the stones below further complicates each selection you make.

Take a close look at this wall's face. Start by following the line of base stones—the stones touching the ground at the bottom of the wall. Note that their uneven thicknesses don't leave very many flat spaces for easy laying of subsequent pieces. You'll see a variety of placement strategies along the line, all intended to bridge the joints between base stones but also leave workable areas above.

It would take a long time to analyze the reasons for each placement even in this tiny piece of wall, but let's follow just one section of it from bottom to top, by way of example. Just to the right side of the wall's center point, you'll see a lighter-colored base stone with a slightly rounded bottom and a two-sided, sheared top that angles to a shallow point. On top of it are two roughly triangular pieces, placed so their narrow, pointed

ends meet the point of the base stone's top. As you can see, the thicker ends of these two triangles drop down into the somewhat differing angles between the light-colored base stone and the flanking base stones to its right and left, covering the joints on either side. But the triangles are shaped in such a way that laying them on their sides over the sheared top angles of the base stone creates a relatively flat space where their points converge. It would have been possible to lay several different kinds of shapes over the joints in the base here, but this choice turns that difficult point on the light-colored stone into a fine, flat bed for the long, straight rectangle that can now cover the convergence of joints made by the base stone and its triangular partners.

But why is that long rectangle offset? Couldn't it have rested directly over the base stone's point and perhaps have looked a little more balanced that way? Yes, but if it had been placed that way, it would have created a pair of running joints—cracks that pass uninterrupted through two or more layers—on either side of itself. The problem is that the rectangular stone is almost exactly the same width as the configuration of base and triangles below, so centering it over that point would have created a structural weakness in that section of the wall. Instead, it was offset to the left to break the joint on that side, and the subsequent gap on its right side is filled with a smaller compensating piece.

The presence of that nice flat rectangle makes the next two layers relatively simple. What you see is a classic two-over-three section, starting with the mottled piece of granite on the right, and continuing with two other stones of smaller dimension and less regular shape. Above those, two other roughly angular stones rest in the shallow, jointed nooks created by the trio below. The one on the left of this group is madly misshapen, but it sits in the joint-space well and has anther virtue, too. It's directly over the very small compensating stone to the right of the long rectangle, but because it's wider than that stone, it bridges it by resting on the rectangle and the bulky, softly square piece on its right. This is how weight and pressure are distributed in multiple directions across a stone wall in ways that provide support and stability both vertically and laterally through the whole structure. In this case, the placement also avoids too much dependency on that small compensating stone, which is inherently less stable than its larger siblings and more likely to squeeze out at a later date.

The right side of the pair of stones that perches on the trio sags away somewhat, so a second compensating piece is needed in order to level and support the stone on top, another roughly flattened rectangle of very dark color. This could be a capstone, or a perfectly workable platform for additional building if the wall was going higher.

Looking now at a few close-up examples of situational placement, we

start with another instance in which an odd gap is leveled to create a solid platform (see photo on facing page). Here, the sloped space between two base stones is filled with a single piece that more or less matches the shape of the gap and also provides an even match for the height of the right-hand base. There's no reason why, if such a match isn't available, the gap couldn't be filled with two smaller stones or even three, but it's always a little better from a structural standpoint to use just one piece for a hole like this if possible. The noticeable space on the upper right corner of the center piece can be filled in with a chip or shard if it's bothersome, but should be done from the back as a *shim*, rather than as a *chinker* from the front.

The important aspect of this configuration is that filling the gap level to the right-hand base stone, rather than higher or lower, creates the opportunity to place the next piece so that it rests on all three of the stones below, breaking both joints between the base pieces and the gap-filler, and presenting a generous surface for subsequent placements.

Here's a situation that occurs over and over in random-shape building: two stones sitting side by side, of thicknesses too radically different to allow the placement of anything over the joint between them (see photo on page 72). Placing a third stone that creates a level platform in combination with the dark right-hand base stone is the obvious solution, as long as the third stone is not the same width as the base stone it sits on. It must be either wider, or, as in this case, narrower, to avoid leaving parallel running joints on either side of the left-hand base. Anticipating the

development of situations like this—imagining what may or will happen as a result of each placement you make—is an aspect of wall-building that takes time to master, but eventually makes you far more efficient with both selection and placement.

The temptation to cluster your most cooperative stones together is ever-present, but should be stoutly resisted (see top photo on facing page). This tight little group of triangles makes a stable and attractive configuration, but every one of these four stones would be far more useful mixed in among the rounded lumps that dominate this stone supply, where their sharp angles and flat sides can be used to form cleats and angled beds for less shapely pieces.

Placing larger stones over groups of smaller ones has a major stabilizing effect structurally, and a pleasing orderliness visually (see bottom photo on facing page). This group could almost be a bench if left exposed as it is here. Built into a wall, it would become a rare example of one-over-five, its slab-like length breaking four different joints once its protruding ends are surrounded by a larger mass.

Tools and Equipment

Stone wall building is not a tool-intensive exercise. A spade, an iron bar, a couple of hammers and carbide chisels, perhaps, and a measuring tape are all that you're likely to need on a regular basis. Other useful equipment includes safety glasses, a few grade stakes, a ball of heavy twine, leather-palmed gloves, and maybe a good pair of steel-toed work boots for those with a habit of dropping things. Most professionals and many amateurs generally work with a machine of some kind as well: a skid-steer or other

front-end loading tractor that can transport quantities of stone from one place to another on the job, or elevate large pieces into positions from which they can be easily rolled or pried into place on the project. For many years, I have used a trusty Bobcat with a pair of forty-two-inch forks that allow me to lift and place stones up to a thousand pounds or more all alone and with surprising delicacy. Builders who work without mechanized assistance can use some of the time-honored methods of our doughty ancestors, which take longer but are just as effective. All of these tools make certain tasks easier, but no matter how many of them you collect, the tools you're going to rely on overwhelmingly are already attached to you: they are your hands. Many projects, you will find, can be done without anything more than these.

Of the other tools, the one you'd probably miss most is the iron bar. Do not underestimate the efficacy of this powerful and versatile tool. I take three of them to my jobs: a six-footer for dislodging very large stones, shifting them in place, or moving them across spaces the Bobcat can't negotiate; a four-footer for lighter pieces or for places where elbow room is limited; and a regular old carpenter's crowbar for very tight spots under buildings or for hard-to-reach sections of a project. All these bars have chisel-shaped business ends—the longer ones come with spear-like points on them, too, but I find they tend to roll or slip off their positions against a piece of stone much more readily than the chisel-tipped type.

When used with a fulcrum—a wooden block or another stone—these bars generate fantastic pressure, multiplying your own strength many times. The longer and heavier they are, the more weight they can move. Iron bars are truly the magic wands of wall building, able to shift and elevate stones that even the Bobcat (rated for 1600 pounds) finds all but impossible to lift. They move stones incrementally—just a few inches at a time—but as my uncle Derek used to say, "If you can move it an inch, you can move it a mile." To raise one end of a long stone that's on the ground, place the fulcrum next to a spot on the stone where you can get the bar's tip underneath its edge. The fulcrum will be more effective the closer it is to the tip of the bar. Now, with the bar under the stone and the fulcrum under the bar, push down. If you're just trying to lift the stone in order to place something else under it (another stone, a plank, a roller), remember that the bar will only raise the stone as high as the fulcrum's thickness before its other end hits the ground. You may have to do this by degrees, putting temporary props under the partially-raised stone, and exchanging your original fulcrum for a larger one that will allow you to pry it up a little higher. By repeating this process at each end of the stone by turns, you can raise a good-sized boulder or slab right off the ground, supporting it in place with a few smaller stones.

If your intention is to move it across some distance, the process is initially identical. When one end of the stone is raised, however, instead of propping it up, simply pull or push the bar sideways in the opposite direction from the one in which you want to move it, as though you were rowing a boat. This will gain you anywhere from five inches to a foot or so. Repeating the process on the stone's other end will put the whole piece that much closer to its destination. The technique can be time consuming over longer distances, but works very handily over short ones, or in places machinery can't reach. If the stone to be moved is too rounded to have identifiable "ends," a fulcrum-assisted bar can be used to roll or flip it a bit at a time to accomplish the same goal.

In cases where the stone is already placed on the wall but needs to be repositioned, look for a natural fulcrum among the other wall stones beside or underneath it. It's often possible to move a stone sideways, forward, or back in a project by prying and rowing against another stone in the course below or to the side. Be careful to choose spots and angles where your hefting won't dislodge the stones already in place, however.

In addition to raising and shifting heavy pieces, iron bars can also be used to break up impacted subsoil when digging holes or trenches, to probe softer soil or forest turf alongside old, collapsed walls in searches for fallen stone, to create pilot holes for grade stakes, or to pry partially buried stones out of the ground. Their effectiveness is much increased when two or more people use them in concert. Three bar-wielding workers can raise an impressively large boulder out of a hole, roll it across open space in almost continuous motion, or flip it up a ramped incline to its place in the project, once they get the hang of working together by applying overlapping doses of leverage in a steady rhythm that keeps the stone moving.

POUNDING, CUTTING, DRILLING

Hammers are useful in stonework for several chores, from driving grade stakes to cutting, splitting or breaking up large or poorly shaped pieces into smaller, more usable ones. I use a stubby little three-pounder most of the time but switch to an eight- or ten-pound sledge if I have to break up quantities of mini-boulders or dismantle an old project that's mortared together. A mason's hammer, also called a brick hammer by some, can be helpful for knocking small projections off otherwise serviceable stones or for chipping away chunks of clinging mortar from others.

Many wall builders routinely cut or split individual stones as they go, manufacturing and modifying shapes to correspond to the developing needs of the project, or to make more efficient use of their supply. There's nothing wrong with doing this unless you're interested in creating a new wall that looks like an old one. In that case, you'll have to hide the fresh edges and surfaces that result from chipping or splitting so that their unweathered coloration doesn't give you away.

When stones have obvious cracks or fault lines, or well-defined, layered grains, it's often possible to split them up with just a few blows of a hammer, especially if you hit your spots with the edge of the hammer's head. But for more precise work, it's helpful to use one of the many available mason's chisels, which are made of specially hardened steel that will stand up to stone. These come in various sizes and shapes; I use one in the form of a simple point, but a broader, flattened head that's more like a wide putty knife is particularly good for splitting with the grain.

The stone arch bridge at Gleason's Falls in Hillsborough, NH, shows precise cutting in the stones of its vault, but the rest of the structure is composed of random rubble.

Now and then, you may also encounter the need to drill holes, whether for the purpose of attaching something to a stone, such as the pintels for hanging a gate, or for splitting up large pieces using the feather-and-wedge system. Hole drilling is best accomplished with a heavy duty electric drill and a diamond or carbide-tipped bit, but for those with lots of time and a yen for old-fashioned techniques, there's also an unmechanized hand method. This involves a tool called a star drill, a short shaft of steel with a round bit in the form of a raised cross—the "star"—which bites into the stone as you strike it. Holding the drill in one hand, you tap-tap-tap it with your heavy hammer (the three-pounder works well for this), all the while turning the drill to and fro to continuously shift its cutting edges to different positions within the developing hole. Star-drilling is not for the impatient or the weak-wristed, but it does eventually produce a hole, and it can be useful in situations where mechanized assistance is unavailable.

SAFETY

Serious injuries in stone wall building are rare. You can look forward to a fairly regular diet of minor cuts, scrapes, and contusions, however, including "the granite kiss," the excruciating result of catching a fingertip under the edge of a heavy stone, usually as you're putting it down on others. I managed to punch myself full in the mouth years ago when the rotten end of a heavy piece I was hefting broke off unexpectedly and got

me before I could react; the bloody orthodontic rearrangement that resulted was the worst accident I've ever had on a job.

Gloves can protect your hands from most nicks and abrasions. They're especially helpful when handling quantities of stone that have been blasted or crushed, which are often covered with a fine and highly abrasive dust that will sand down the skin on your fingertips right to the nerves in just a few hours. When I use gloves, I buy the leather kind because they hold their grip on the stone more consistently than cloth ones, and last longer, too.

But gloves have a downside. For one thing, they can slide around on your hands, particularly when you're picking up heavier pieces. They may have good contact with the stone, but if your hands are slipping out of them when you lift, the chances of dropping something on your feet are much enhanced. For another, it's not always easy to be sure exactly where your fingers are when they're gloved, so reaching into nooks and underneath spaces where you can't see them becomes a little riskier. Unless it's too cold, I typically don't wear them at all.

The situation with footwear is somewhat similar. It's smart, of course, to have something on your feet that will fend off the occasional dropped stone, and plenty of builders operate in pairs of steel-toed boots as a matter of routine. But if you let go of something really heavy and large, that little metal cup over your toes isn't going to help you much, because the rest of your foot isn't similarly protected. It can even be crushed down onto, or into, your toes if the object that hits it is heavy enough.

So I opt for mobility over armor. I've noticed, too, that I don't drop stones straight down much at all—it's usually off to the side or from a stooping or bending position that aims them away from my feet. With the light ankle-length canvas shoes that I mostly wear, I can get out of the way a little more nimbly than if I'm plodding along in heavy work boots. It's helpful to be light-footed, too, when you spend a lot of time picking your way through scattered messes of stone in and around your supply pile.

Tripping and falling seem to be the most constant threats in ordinary wall building, because when you're lugging a heavy stone, you may not always be concentrating on where you step. One ill- advised footfall on a loose rock that rolls over when you step on it can send you and the stone you're carrying into a shared plunge to the ground, with an outcome that can never be good. That's why it's common practice for builders to leave a four- or five-foot space of clear ground between the project and the stone pile, all the way along. An area of solid footing beside the project does more to avoid accidents than most other precautions you can take.

If you're going to be hitting stones with a hammer, the one piece of equipment in wall building that is unequivocally essential is a pair of safety glasses. Stone behaves in unpredictable ways when it is struck, sometimes cleaving along neat lines, other times spraying stinging shrapnel in every direction. A ten-pound sledge can release razor-edged chips moving with bullet-like speed that can do damage to anyone within ten feet or more of the hammer-wielder.

CHAPTER 4

At the Musterfield Farm Museum in Sutton, NH, the solid bulk of a double-faced roadside wall harmonizes easily with the classic Yankee barn across the way.

Planning and Design

I did some repair work recently on a relatively new wall in my neighborhood. The wall sits in the middle of the lawn of a large house on a little rolling hilltop lot. It's about thirty-five feet long, slightly s-curved, perhaps twenty-eight inches wide and a little over three feet high. The wall should not have needed repairs after only

about twenty years of life, but it was built a bit too narrow for its height, so its two butt ends, somewhat carelessly laid, were beginning to fall apart. I remembered thinking, while watching it under construction years before, that one day I would be fixing those ends.

But collapsing butt ends are not this wall's principal failing. The real problem is its design. All alone in the middle of an expanse of grass, it is connected to nothing, expresses no purpose, does not mark any boundary or topographical change. It protects no flower beds or shrubbery, and isn't close enough to the road *or* the house to be visually associated with either. Perfectly attractive by itself, it fails as design because it has no job, no part to play in the landscape. It's an orphan remnant of an unrealized idea. No one would mistake it for a traditional piece of stonework.

Making decisions about where to put a wall, its function, dimensions, style, and spatial relationships to topography and other features of the landscape was probably simpler in the old days than it is now. Farm layouts are governed more by use than by appearance, and their traditional alignments tend to take advantage, when they can, of whatever natural warmth, light, and protection from wind and weather may be available. This is especially true in the northeast, where winters are harsh and the sun's angle changes radically from season to season. One of the ways to distinguish an old house from a newer one, for instance, is to note the direction that its main entrance (the everyday door, not the formal one) faces. Houses built after central heating and the automobile became common are usually aligned to the passing road, or to their own driveways. Older farmsteads turn their faces to the sun wherever possible, so that their dooryards—the important transitional space outside the kitchen or other regular entrance—is facing south or east, where it will be warmed quickly in the morning and sheltered from north and west winds by the building itself. Barns and barnyards, even fields, are often placed the same way. Their points of reference are the compass and the lay of the land, not the road or the connecting driveway.

The layout of stone walls on an old farm is generally centered on the cluster of buildings at its core, but largely determined by topography and function. Enclosed spaces for mowing, pasture, and planting were smaller and more numerous in the days before farming's nineteenth-century mechanization. Access to these spaces was often created by lanes of parallel stone walls running between groups of separated fields. These lanes usually originated near the barn, so that the constant traffic of people, carts, and animals could move efficiently back and forth without cutting muddy tracks into the fields themselves or disturbing crops or

grazing flocks by running cross-lots. The pattern of walls on a farm like this was sometimes close to being completely integrated, few parts of it disconnected from all the rest.

The old system of wall placement rested on several considerations: the flow of the land, its intended purpose, the size of the parcel in light of that purpose, and the potential to enclose it using straight lines. Walls often occupy the borderlines between sections of differing uses or dispositions. Perched on the edges of drop-offs or swales, used to divide dry from marshy areas, smooth from rough ones, or vertical from flat, they also separate the woodlot from the cornfield or the public thoroughfare of the road from the private property of the farmer.

Looking at the remains of these old landscapes, we can't always be certain of the specific uses to which they were originally put. Thickly reforested fields, the extensive deterioration of the walls themselves, and the absence of features like gates, stiles, and bar-ways obscure original schemes. Walls were placed to keep things out as well as in, and this, too, is a complicating factor in any effort to divine the reason for their placement. Even so, the old walls project an undeniable sense of purpose. Stonework, by its very nature, expresses effort and perseverance, but only when incorporated in a larger pattern of use does it take on the air of purposefulness that connects it to tradition. Without that connection, even an exceptionally well-built wall has a hard time looking like much more than a particularly rugged form of decoration.

Stone walls separate things, but also connect them. Exceptionally effective as definers of space, they also help unify overall design schemes by creating contexts for other elements, like flagpoles, flower beds, furniture, walkways, and so on. Finally, they are great regulators of traffic. They tell you where the entrances are, usher you in, out, or onward to another space. In this respect, they aren't much different from those old cow runs, the pairs of parallel walls that guided cows and sheep to their daily grazing.

Decisions about placement can draw considerable inspiration and guidance from older stonework, whether it's incorporated in contemporary landscaping designs or simply serves as a model for elements of those designs. Conversion of exposed foundations to garden or patio spaces, or restoration and even extension of old sections of wall can create spaces that respond to current tastes and uses while preserving reminders of the region's historic past. Even new stonework can connect itself to traditional landscapes and structures as long as it retains some of the characteristics of function and composition familiar to us from the surviving examples of yesterday's vernacular masterpieces.

If my neighbor's orphaned fragment of wall were closer to the road and

long enough to mark off the entire length of its yard's frontage, it would succeed as design because its job—separating public from private space—would be clear. If it enclosed all or part of its yard instead of floating aimlessly in the middle, if it served as anchor and protection for planting beds on one or both sides, or if it were connected at one end to either of the two very old roadside walls that flank the opening to the property at the lawn's outer edges, it would also succeed. If the yard's grade changed its elevation on the way across to the house, the wall could have been built as a retainer, dividing the space into two sections connected by a set of steps, and found its job that way. It could even have been constructed as a circular raised planting bed surrounding the yard's flagpole, which would at least have mitigated its isolation by making it the guardian of Old Glory.

The question of a wall's dimension, for instance, doesn't receive as much attention from homeowners and landscape planners as it ought to. Many contemporary designers favor relatively short, narrow walls, with heights under thirty inches or so, and widths in the twenty-four-inch range or less. These modest constructions, with their typically careful selection of individual stones, tightly squared and flattened ends and caps, and artful, mannered curves, express a refined propriety that's a long way from the hearty practicality of the past. Northeastern walls lose a certain vitality when the famous irregularity of their component stones is too subdued in forms and patterns more concerned with control than with creative response to the eccentricities of their materials. In the context of a landscape whose antique stonework makes a virtue of inclusiveness when it comes to random shapes, such walls carry an air of gentrification, like a dress code at a restaurant. It's harder to perceive them as having been derived from their surroundings because they aren't built from a fully representative selection of what those surroundings contain.

The four-foot walls of an old town pound in Hillsborough, NH, set aside a quiet nook ideal for a secret garden or private sitting area.

Taller, thicker walls avoid this kind of visual disjunction by making it easier to employ a wider range of shapes and sizes. Even a relatively small expansion from the standard twenty-four by twenty-inch garden wall, to perhaps thirty or thirty-six inches in height and twenty-four to thirty inches wide, allows room for a much less restricted use of your stone supply. This not only eases some of the difficulty of acquisition but makes the building process itself proceed more smoothly. With wider, taller dimensions to work with, opportunities for the placement of particular shapes are multiplied, and the efficient use of a larger proportion of your supply is enhanced.

Taller walls are appropriate in cases where a stronger sense of enclosure or privacy is desirable, where protection from the wind is part of their function, or where it's necessary to establish boundaries that cannot be casually crossed. They can be used to add a bit of mystery to a landscape design, hiding some of its nooks and crannies in a way that draws the viewer in. Shorter walls leave everything open to the eye from all angles—you're looking over them no matter where you stand—but three and four foot walls leave much to the imagination and hold the promise of pleasant surprises for those who enter their enclosures. They also stand out more strongly from a distance, strengthening their presence in the larger landscape and connecting them to the patterns and proportions of older stonework, even when their functions are quite

different.

Professional builders overwhelmingly favor a tight, flat style these days that requires careful selection of individual face stones and often calls for cutting and reshaping to produce a high degree of conformity in a finished wall's appearance. Decorative or landscape stonework has been trending this way for a long time, in some places as far back as the decades just before the Civil War. The emerging symbolism of stone walls as a sign of care and thoroughness in farming itself led even the region's traditional agricultural builders to distinguish between the rough, mounded unevenness of purely practical fencing and the more precisely shaped and finely fitted work they created within sight of their houses or the public view. In time, this distinction became a kind of prejudice against the older, less fancy style, and as farmers abandoned the wall business, aesthetic appreciation of the style waned.

That situation is now changing. One of the results of the residential building boom of the last thirty-five years or so, and the renaissance in stone walling that has accompanied it, is an increasingly widespread admiration for the old agricultural network of walls and other stone structures, and for the styles in which they are built. Observers of the old landscapes now are more likely to look on the random roughness of antique walls as achievements of authenticity and ingenuity, not carelessness or lack of craft. This is why we are sometimes asked by clients not to make our stonework look "too nice."

The assumption that modern decorative or landscape stonework ought to be built in a refined style is probably more a product of professional masons' pride of craftsmanship than anything else. In fact, random rubble walls are every bit as pleasing as the finest, most precisely fitted ones because their familiarity in the landscape makes them look right at home, even in strictly decorative settings. This should be good news to beginning and amateur builders, many of whom have long since learned that the specific style of a stone wall is not nearly as crucial to its aesthetic excellence as structural integrity and consistency of pattern, no matter how rough or smooth.

How To Make A Wall Look Old

The persistent legend that certain substances can be obtained that will cause stones to quickly develop the weathered patina so prized by aficionados of antique stonework is as difficult to confirm as it is to refute. Claims that special tea made from manure or exotic concoctions of buttermilk and mare's urine seem to crop up everywhere, although no one

has ever shown me a recent wall that actually developed its ancient appearance through the use of one of these substances. Those who suspect or insist that such things exist never seem to get around to explaining why our predecessors would commit perfectly useful food and fertilizer to accelerate an unnecessary transformation that occurs by itself without help.

Still, as builders who frequently restore old stone structures and create new ones that mimic the appearance of antiques, we've learned a few tricks over the years that can move the process along. Most of them are commonsense techniques derived from old-time habits of building, but some anticipate the effects of time by making those effects part of initial construction.

1. Build with weathered stone. This is the most obvious starting point, but it comes with some qualifications. First, only the stone that shows needs to have any color to it. For walls with substantial interior space, six or eight-inch riprap, or any old unweathered junk will do. Second, try to use material whose weathering is consistent. Site conditions tend to produce similar coloration on most, if not all, of the exposed surfaces of a structure, so beginning with stones that are already alike puts you ahead of the game—even if their colors change over time.

2. Lay out and construct by eye alone. When you establish the project's base, drive a stake at each end, then stand back at one end or the other and position the base stones by visual proximity to the imaginary line between them. If the wall is double-faced, you can use four stakes to establish the outside faces. If it's a single-stack, set the stakes so their line runs down the middle of the wall as a guide to placement of each stone's center of gravity. If the wall is curved, draw a line freehand on the ground, using the sharp end of a stake or some other tool, to mark its outside face or faces (you may have to do this several times until you're happy with it). As the wall rises, continually check its adherence to these theoretical lines, either by standing back at one of the ends or by standing directly above any point of its developing face and looking straight down in case individual stones or small sections are beginning to wander in or out.

   This method can produce surprisingly straight, vertical, or evenly curved structures, but it also virtually guarantees that there will be minor anomalies in numerous places along its face, with some stones or groups of stones a little too far in and others a little too far out. These anomalies mimic the shifts and settlings that begin to appear here and there in older walls as years pass, helping to disguise the

wall's newness.

3. Mix stone sizes throughout the structure. Resisting the temptation to place most of your large stones in the wall's base and generally graduating to smaller ones as the wall rises tends to produce a pattern that gives away its modernity. Though it may obligate you to heft some pretty challenging chunks into positions two or three feet off the ground, mixing your sizes helps produce a face that looks less like a plan and more like an improvisation.

4. Use the crazy shapes. Within limits, of course, but the inclusion of some of those wild geometric oddities we all run across from time to time, and your efforts to build around them that often produce additional oddities of fitting, help make the impression that the builder made an attempt to use everything that came to hand. This sense is a regular feature of old Northeastern stonework, especially evident when you dismantle some of it and see the tortured compensatory ways the old-timers used to make certain shapes fit in.

5. Don't cut, split, or reshape anything that shows. Aside from showing fresh sides and edges that betray your wall's youth, reshaping tends to produce surface patterns that look more planned and selective than older work. Taking the time to fit unaltered natural shapes together as best you can may make less efficient use of your supply, but also strengthens the impression of random variation and adjustment that characterizes vernacular building.

6. Avoid fancy capping. No matter how they're composed, unbroken, flowing caps make a wall look well-maintained, even new. Once the bulk of the structure is in place, lay the last stones in casually, allowing a gap or two to interrupt its line here and there. If the cap is a single line of stones, leave a few out or use capstones of slightly unmatched thickness. With caps of multiple smaller stones, mound them over a bit rather than trying for uninterrupted flatness. Even if you cap the piece with slabs or long shards, set them end to end in a wavering, not perfectly straight, line.

CHAPTER 5

The 1805 Hopkinton, NH Town Pound, now hardly more than a jumble of jagged blocks, is a candidate for restoration.

Repair and Restoration

The habit of maintaining stone walls, of repairing the ordinary topplings and collapses that eventually afflict them all, began to flicker out on New England farms even before the appearance of barbed wire in the 1870s. By 1915 or so, when Robert Frost wrote “Mending Wall,” it had all but disappeared as a

common feature of rural life. Frost explained why with typical succinctness. “There where it is we do not need the wall,” he admits, for “here there are no cows.”

Frost tries to sound ambivalent about the annual repair his wall requires. “Something there is that does not love a wall,” he famously begins. He plays with the irony of the task, hard labor for no practical purpose, and characterizes his anonymous neighbor as a shadow-figure, set in his anachronistic ways only because they were his father’s before him. But Frost himself is the one who calls the date, who arranges for the work to be done. It may be that frost does not love a wall, but—though he can’t quite say so in his poem—there’s another Frost who does, and wants it fixed.

Simple Repair

There are essentially two ways to go about repairing dry-laid stonework. Frost and his neighbor practice ordinary maintenance, simple repair that only seeks to replace what has visibly fallen and to fill in the most obvious gaps. The wall they share is a single-stack, so this task is relatively straightforward. Just pick up the stone and reposition it in the hole it came from. If multiple holes have appeared in close proximity to one another and the expelled stones don’t clearly match them individually, make your best guess and leave it at that, without worrying about which went where originally; it’s a commonplace in stonework that one can never build the same wall twice. If groups of stones have fallen together and left a larger gap, build it up stone by stone from bottom to top, making sure to leave stable platforms or valleys for each succeeding layer as you go. This often means you’ll use the larger members of your supply lower in the wall. Gradual diminishment in size regularly appears in single-stack work because it’s easier to find perches for individual stones on or between slightly larger ones.

Single-stacks are the most delicate and easily disturbed of all walls. Anything from a falling branch to a scrambling animal can knock stones off them, and when these go they often shift others below or beside them out of line, destroying the platform where the fallen stone once rested. Part of simple repair, then, is checking to make sure the stones that remain in place are sitting stably and continuing to offer spots where others can be set. Unstable balancing through multiple courses is a good way to guarantee you’ll be back at that section a lot sooner than you may have

intended, so don't hesitate to reposition stones that may not have fallen themselves but can no longer support the ones that have.

When fallen stones are too heavy for you to lift off the ground and you aren't working with a machine that can raise them to the height you need, there are a couple of ways to roll or pry them into position without picking them up. One is to create a temporary ramp or rough stairway out of other stones, at an incline shallow enough so you can raise the offender by degrees, rolling or flipping it up to its eventual perch. This can also be done with a five- or six-foot piece of heavy plank if you don't have enough extra stone around to throw a ramp together. If the stone has some length to it, you can raise it with your bar, one end at a time, onto stacks of stone or wooden blocks that you add to with each lift until it's high enough to shift over onto the wall. These techniques are effective for short lifts of two or three feet, but they grow less reliable at heights above that.

The issue of extra stone comes up frequently in most types of repair. Stones may have been pilfered, used elsewhere in previous maintenance work, or simply removed. With single-stack types, this doesn't usually amount to a great deal of volume, so it's an instance where a pallet of more or less matching extras from a commercial stone yard can be helpful if you don't have access to a ready supply. If the wall is an old one, however, and sits on land that has long been reforested, the stone you need may already be present in the ground along the wall itself. Toppled stones lie buried by the millions along the older walls all over New England, and a little probing with your trusty iron bar can find them and restore them to their places.

Hillsborough, NH's Carr Bridge is a superb example of dry-laid arch work. The bridge was built in the mid-nineteenth century, and expertly repaired after floods damaged it in 1936.

When the wall is double-faced, simple repair loses some simplicity. This is because its stones are not individually balanced in place, but trapped in a mass that distributes weight and pressure in many directions. Gaps and disturbances at or near the top of the wall aren't much more difficult to fix than in a single-stack, but when the problems are lower in the structure, things are a little more involved.

Bubbles and Blowouts

Single-stack walls tend to develop their troubles from the top down, double-faced and retaining walls from the inside out. Face stones that are too shallow or simply misplaced can be pushed out by the settling core of the wall, a phenomenon that is exacerbated if the core is composed of too much very small material that can work its way in between the larger outside stones over time. Each minor disturbance (a little earthquake, traffic vibration, a frost heave, tunneling or erosion underneath) makes the problem worse by opening space between individual face stones and the interior that the settling core stones can enter. The results, sooner or later, are *bubbles* and *blowouts*. A bubble occurs when a section of the wall is visibly pushed outward beyond the plane of the wall's established face, a blowout when one or two stones let go and fall out entirely, causing a section to collapse. Simple repair of either of these requires a certain amount of dismantling before the fix can take place, because the interior of the wall must be reordered along with the outside face. In freestanding work, you'll often find you have to rebuild the opposite, intact side of the wall as well, because removal of the structure's interior deprives it of its support, sometimes sending it crashing into the excavation you've made on the damaged side.

Dismantling a bubble or blowout should be done carefully, from the top down, one stone at a time. Your goal is to clean the wound completely by removing not just every stone that's fallen but also those that have been disturbed or deprived of support and are no longer sitting solidly in their spots. This often involves the removal of a fair amount of material that hasn't fallen or bubbled out, so that the scoop-like hollow you create has stable sides and a relatively flat, deep bottom. Once you've done that, you're ready to build it up again.

Bubbles and blowouts usually occur because the face stones in a

particular section don't run deep enough into the mass behind to function as secure anchors that make the wall a single structural unit. You can often find the culprits as you dismantle, stones that are too shallow, too smooth, too tapered to be held in place effectively, almost always at or near the bottom of the disturbance. These should be replaced with long, thick face stones that reach as far back into the interior as possible and can be tightly packed in the rebuilt core so they will not move out again. Building up the remainder of the section after that isn't much different from the initial construction, but make sure you have some extra material on hand, even if it's only four- or six-inch riprap. The tighter the fitting you put into your repair, the less space there will be between stones than before, so the volume of material you will need to fill the hole will be greater.

Restoration

Simple repair uses little more than the stone that's already on the site to patch and tidy up an existing wall, however altered it may be from its original dimensions and condition. Restoration seeks to reconstitute those dimensions and condition, insofar as they are known, by rebuilding from the ground up. This almost always requires complete dismantling, particularly if large amounts of stone must be added to restore the wall's original size. It is even possible, if the piece contains more or less intact sections, to reproduce the stylistic peculiarities of the original along with its structural and functional characteristics.

Discovering what those were is not always easy. Some kinds of walls—foundations, wells, heavy single-stacks with undisturbed sections—make their original conditions unambiguously clear. But others—freestanding walls in advanced states of collapse, combination retaining/freestanding structures at the low ends of sloping fields, fragmentary single-stacks in remote spots, any wall that's been extensively picked over—are much harder to figure. Sometimes the sheer volume of stone on site suggests a general dimension. Sometimes the width or extent of the wall's base course does the same. Types of stone can offer clues, too. A low, rounded mess of small stuff no bigger than a cantaloupe may never have been much more organized than it appears today. A tumbled heap that's full of flat rectangles and square corner stones at the end of a wall was once a carefully laid butt end. Spread-out formations of uniformly large stones scattered over a very narrow base suggest a formerly solid single-stack.

Restoring a wall to reflect its original function doesn't obligate you to sow a cornfield or acquire a flock of sheep, but it does mean you should

make some effort to find out how the land where it sits was used. That immense collection of baseball-sized stones by the thousands, whether in a low, spreading mound or contained by larger outside lines of boulders, almost always sits beside what was once plowed acreage. A rough single stack with intact sections up to four feet high and strands of crumbling barbed wire emerging from the leaves here and there along its length indicates a former pasture. Crowds of huge boulders pushed randomly up against the unmaintained wreckage of an even older wall were likely hauled into place by early heavy equipment, which began to appear on farms in the 1930s and ’40s: These suggest that the field was used for mowing. New England has always been a good place for making hay, but the presence of surface boulders, which could easily be mowed around when that job was being done with scythes, became a nuisance as farmers switched over to machine mowing. The boulders had to go.

When no particular clues are forthcoming from the evidence on the ground, histories of use can sometimes be established from public records of various kinds. Town reports and histories, tax records, title searches that trace the succession of owners, personal memoirs by longtime residents—all these can offer information. In New Hampshire, we also have the renowned White Pine Blister Rust maps, an enormous trove of hand-drawn documents created between the late 1920s and the early ’70s as part of a fight against a fungal disease attacking our most valuable timber tree. These maps contain uniquely detailed drawings that show the relative proportions of open to forested space, species composition in both cleared and wooded land, wet and dry areas, roads and lanes that have since disappeared, cellar holes, patterns of stone walls on long-abandoned farms, and many other details. Much of what they show provides clues to the farming activities of even earlier periods.

A small blowout in this old freestanding wall reveals interior stones that have weathered differently from the exposed builders on the surface.

Cleaned out for rebuilding, the hole grows when loose interior packing and partly dislodged face stones on its edges are removed. The cavity now has a solid bottom on which to rebuild.

Three new face stones are set to begin the reconstruction, placed with long ends in.

Seen from the top, the replacement of interior packing keeps pace with the addition of new face stones, so that a level platform for the next course is constantly maintained.

Two courses later, the repair is complete. Can you find the three initial replacement stones that began the rebuild?

Of course, many candidates for restoration don't call for time consuming off-site research because they contain more or less intact sections that make their former configurations clear. It's a good idea to leave a few of these in place, if you can, to preserve a bit of the original work, just as architectural restorers nowadays will leave a square of old paint or wallpaper on the refurbished walls of a historic building. They can also serve as a template for the visible pattern of face stones in your rebuilt structure. If you do this, be sure to choose sections that haven't loosened up too much or wandered off line enough to call attention to themselves.

Style and Substance

When a restoration job begins with complete or nearly complete dismantling that leaves little of the original for comparison with your new work, individual style doesn't matter very much. Just concentrate on soundly reproducing the overall dimensions of the piece, and the stone itself will create the style, as it so often does in New England building. But if you're only restoring parts of the wall, or if intact sections have a particular look to them that you're interested in recreating, it's important to study the older work very carefully. Most walls have a particular style of their own, and while this may be deliberate or simply an outcome of technique and the characteristics of the available stone supply, it's usually something that can be defined specifically enough to serve as a guide to how you're going to lay out the surface pattern of your reproduction.

First is the stone itself. What is its range of shapes and sizes? Is it dominated by any particular type, whether rounded and worn, broken randomly or squared off and rectangular, or is it a mixture of these? What kinds of sizes does it feature? Is it mostly material you can lift, or does some of it have to be rolled, barred, or set in place by machine? If it contains a generous proportion of stones the size of a bushel basket or larger, does it also have plenty of smaller pieces in a variety of shapes?

The slowly tumbling remnants of an old mill race in Hopkinton, NH, testify to the rough integrity of its early-nineteenth century construction.

Second is the pattern of distribution in the wall's face. Do the largest pieces appear only near or at the bottom, or are they set in other spots higher up as well? Is the range of stone sizes relatively evenly mixed across the face, or does it vary in some way? For instance, a wall mostly composed of large, rounded boulders may show a pattern dominated by their broad faces but surrounded in each case by much smaller stones set in to fill the gaps between them.

Third, is there any consistency to the laying of particular shapes? Broken or flattened pieces often have straight lines along one or more of their sides—are these mostly or entirely laid parallel to the wall's baseline, or do they appear at angles, vertically, or in no consistent position? Are odd shapes like squares, triangles, or long thin plates always presented the same way in the face, or do they, too, find various positions? Is there any sense that the original builder tried to create a consistent pattern of seams between stones, or is the wall an unplanned jumble of random cracks?

Individual style also appears in the relative degree of flatness the original builder preferred in his face stones, as well as in the way they are aligned with the plane of the wall as a whole. Some builders show nothing but the flattest, sheared ends or sides of their face stones, while others, less strictly, use rounded or even snout-like ends out front. As we noted earlier, standards for acceptable faces on individual stones determine the

comparative roughness or smoothness of the finished wall as a whole. Even a wall that features mixtures of sheared and rounded or uneven faces will usually display a proportionate consistency you can recognize and imitate. Notice, too, how carefully the original builder lined up the planes of each face stone with the larger surface of the entire structure. Are they laid to reflect the flow and direction of that surface precisely, only in a general way, or not at all?

One of the trickier things to determine when restoring an extensively collapsed old wall is whether or not it was originally battered. Even when intact sections appear to be sloping in as they rise, the possibility exists that the wall was built vertically at first, and only later leaned inward as its interior settled and shrank. This frequently happens in double-faced walls with cores that were not carefully placed or were composed of too many small stones. If there are several intact runs of original face left to study, you may be able to discern some consistency in this respect, but if the structure is mostly down and there are no similar walls nearby in better condition to offer any clues, your best guess should be that the original was built straight up: New Englanders did build walls with battered sides on occasion, but not as a general rule.

Taking note of the basic patterns in the older work helps you know how to treat the material you'll handle when you dismantle the sections to be replaced. There may be stones in the middle of a ruined wall that can be promoted to duty in its face, depending on the structural and stylistic needs of your reproduction. These can be set aside or simply remembered as you go. Make sure you set the stone you move a good four or five feet from the wall's footprint to give yourself a clean working area. If the wall is double-faced, try to pull away equal amounts of stone to both its sides so you won't have to clamber over the developing new wall too many times with heavy loads as you rebuild. Checking the condition of the wall's base as you clear it off (see Chapter Two) is also important.

The restoration of larger walls, particularly retainers and double-faced freestanding ones, frequently calls for a surprising amount of extra stone. Whether the old work has been picked over or pilfered by thieves or former owners, has settled into the ground or been buried by a rising forest floor for generations, or simply collapsed into a smaller area than it once occupied, it's all but certain you'll need more stone for its resurrection than what's available on site. If the extra volume is primarily destined for the invisible interior, cheap and handy six-inch riprap will do nicely. But if an old wall has served as a source of supply for other uses over the years, chances are that most if not all of the decent builders and face stones have disappeared—they are disproportionately attractive to legitimate and larcenous gatherers alike.

Replacing these with similarly weathered stone returns you to the

acquisition considerations of Chapter One, but with a twist. This is the challenge of matching. Weathered New England fieldstone may look pretty much the same to untrained eyes wherever you go in the region, but finding identical combinations of color and texture in supplies that come from different locations is almost impossible. The combined characteristics of separate sites—exposure to moisture, to sunlight, to wind, to vegetation, to temperature, as well as the length of time and the intensity of these exposures—produce a large array of different surface colors and growths, each unique to its spot. You can often come close, but you'll hardly ever find perfect matches for the patina of a wall's original stones.

This is another reason why complete dismantling is helpful in restoration work. When new material, more or less inexactly matched, is necessary, mixing it together with the original stones before rebuilding ensures that the reconstruction's appearance will be consistent throughout and will not betray its contemporary augmentation too obviously. Even if you can still tell the difference on completion, others won't be able to. And, of course, you can always remind yourself that a hundred years from now, they'll all look the same once again.

CHAPTER 6

This arched opening is built into an eighty-foot causeway more than ten feet high that crosses Beard's Brook in Hillsborough, NH.

Learning Curves of the Self-Taught

I play a game with my students sometimes called Fuzzy Ducky. The object of the game is to count to forty out loud. Not much to that, they think. But then I tell them the rest: That on your way through the numbers, every time you come to one that has a three in it, or is a multiple of three, you say *fuzzy* instead of the number

itself; that every time you come to one that has a seven or is a multiple of seven, you say *ducky;* and that if you should happen to land on a number that contains or is a multiple of both three and seven, you say *fuzzy ducky* in its place. Suddenly the journey from one to forty is considerably more complex. You have to check down a list of possibilities with every numeral, and it's easy to forget where you are in the count, especially when you try to negotiate the thirties. The game forces your mind to conceive of several potentialities simultaneously without losing sight of the basic objective.

This is what it's like to learn to build stone walls, except that the instruments of the task in stonework are objects, not abstractions. Fuzzy Ducky is a numerical multi-tasking exercise, stone wall building a tactile and visual one. Learning to do it is about learning to see not just what is in front of you, but what is coming next and how each new stone you place changes the possibilities. Like Fuzzy Ducky, it encourages a habit of mind that anticipates the future by weighing the effect present actions will have on it.

Describing this process makes it sound more formidable than it actually is. Still, every new builder has to wrestle with it until it begins to become instinctive. This takes time and patience, more for some than for others, but since the maze of interdependent details that arises during individual selection and placement—all those equivalent threes and sevens—can easily frustrate and confuse a beginning builder, it may be helpful to suggest a few simple ways to manage your early efforts so that the work becomes methodical rather than mysterious as soon as possible. It will not be long before you begin to find your own way of doing things, but until that happens, these tips will help you avoid wasting your time and energy.

Gather an adequate supply of stone before you start.

"Adequate" in this case means two things: quantity and variety. It's extremely frustrating to find good placements for individual New England fieldstones when the available supply is too small to offer a generous range of choices of shape and size. Our region's stone, so much of which is randomly rounded, is not just difficult to place soundly by itself, but it also leaves equally random and difficult spaces as it is placed. Without a large selection of the most varied shapes and sizes you can locate, your chances

of finding the right pieces for all those maddening in-between spots are severely restricted, and this will immediately tempt you to start compromising the integrity of your project by putting stones where they don't belong in order to use them up.

What's a "large" selection? One way of determining this is to think of the supply pile as a percentage of the intended volume of the completed project. Simple multiplication can tell you, for instance, that four linear feet of two-by-two wall will contain sixteen cubic feet of stone. If it's all or mostly granite, that amount weighs about 2400 pounds, almost a ton and a quarter. That's considerably more than most half-ton pickups can carry, yet not a great deal when you're looking at what it can build. A loose pile of stone always takes up more space than a finished wall, too, so what may appear to be a fine supply can thin out very quickly once building begins. If your dainty little two-by-two runs out to thirty feet in length, you're now talking about 120 cubic feet of material with a weight well in excess of nine and a half tons. Bringing even half that to the job before you begin will make a righteous mound of stone, yet you'll find its sheer volume offers enough variation in size and shape to make the building process far more efficient and satisfying.

Of course, the circumstances of acquisition and available space on the job site may prevent you from stockpiling as much stone as you'd like to all at once, but the more you have on hand, the better your experience will be. For large jobs especially, we've routinely delivered up to 20 or 25 percent more stone by volume than we know we'll need. Hauling away the

unused portion afterwards takes less effort, and is less expensive for our customers, than poring over remnant piles of junk for hours in a doomed attempt to use it all.

Don't waste good stones.

Learning to distinguish the useful from the ordinary and the ordinary from the impossible takes less time than some other aspects of stonework, but it's still a challenge for many beginning builders. While some shapes are clearly suitable for use in faces, on caps or in corners, as steps or in walks, others may seem ambiguous. Some that are wildly misshapen or merely odd are actually precious *problem-solvers*. And there is always a number of what we call *cheap seducers*, stones that seem at first glance to be ideal for a particular purpose, yet turn out to carry some flaw, often an apparently minor one, that prevents them from being properly laid or creates spots or spaces that can't support or accept stones yet to come.

Experience and your own developing preferences will quickly begin to teach you to distinguish one shape from another even if the differences between them are small, but until this sensitivity ripens you'll regularly be tempted to throw away perfectly good stones by burying them in the interiors of your projects. In general, then, as you work your way through a supply, take especially close looks at anything flat, anything long, anything square or rectangular, anything broken, sheared, or otherwise angular, anything with parallel flat surfaces, anything with a face. Shapes that are blade-like or triangular, or that resemble cigars or ax heads or saucers, including the smallest stones in your supply, all have uses that make it inadvisable to waste them. New England has plenty of excellent stones for building, but they're typically sprinkled at random into great stews of lumps and chunks useful mostly as interior bulk. Since the good ones make it possible to employ the rest, you'll do well to learn to spot them as soon as you can.

Work methodically in a defined area, and in steps.

Breaking down the phases of a project into stages helps you avoid getting lost trying to do too many different parts of the piece at once. It also gives you specific goals for each session of building, so that you aren't thrashing away at the entire job every time you go out to work. Unfinished

stonework isn't very satisfying to look at, so it's possible to get discouraged if you're partway through and the task is beginning to seem both formless and endless. If you know what you're trying to accomplish each time and stop when you've done it, you'll leave with your enthusiasm intact and the project in better shape to receive the next phase of building.

Focusing on a defined area is also helpful. I generally stay within the same ten- to twelve-foot section for each three- or four-hour stretch of building. An area about this size is small enough to allow me to make some visible progress, but also long enough to give me a good-sized number of spots where stones of various sizes and shapes will sit well. Working an area that's too small leaves you with too few possibilities for placement, thus slowing the work down while you search for elusive shapes that will fit one of your limited vacancies. When I worked with members of my family, we would often each concentrate on single, separate areas for a while, then exchange them, bringing fresh eyes to someone else's problems.

Phases of a job can be imagined in lots of different ways. For a double-faced, freestanding wall, I might lay down the outside base stones on both sides for a dozen feet or so, then place the interior base between (being careful to use the largest stones that will fit the spaces without rising any higher than the outside face stones in front of them) and pack any interior gaps with smaller material to make a tight, dead-level platform for the next course of face. Rinse and repeat, and you're on your way.

For retaining walls, I generally lay out a wider section, up to a rod (sixteen and a half feet) or more, because the single face of a retainer requires only half the face stones of a freestanding wall and so provides less available space per lineal foot to work with. It does, however, have far more interior space, so the task of backing up each section is more strenuous and time-consuming. Enormous amounts of terrible stone can be exiled to the backside mass of a retainer, so I'm careful to keep the developing face fully backed up as I go. This gets a lot of stone out from under my feet in a hurry, and also exposes the best of my material as the pile begins to shrink, making the search for face stones that much easier. Two or three courses of this, backed up, is a pretty good session.

If the project is a single-stack, I lay out as much as a two-rod stretch, since the task is confined to the balancing of individual stones and there is no face or interior to account for. Perhaps I will shoot for two or three courses at a time on such projects, or split the session between completion of one section and the initial layout of the next. If the job has specialty features like steps or butt ends, I'll set aside a whole morning to concentrate just on those rather than patch them together piecemeal while I'm also building other parts of the piece. The point is to have a plan that focuses your effort, giving you a much better chance to make steady

progress with every outing.

Work forward, not backward.

The great Scottish stonemason Ian Cram put it this way: “Pick the stone for the spot, not the spot for the stone.” One of the pitfalls of learning to recognize outstanding builders is the impulse to grab them immediately and go looking for a place to put them. When you do this, however, you are working backward, picking the spot for the stone instead of the other way around. Will you find a spot? Maybe, maybe not. If you do, swell. But if you don’t, you’ll still be standing there hefting the stone. Perhaps you’ll start wandering down the line, searching, still hefting, finally admitting defeat, putting the stone back on the ground, wasting your time and energy.

Working forward begins at the wall, not the pile. Learning to spot good builders is important, of course, but learning to characterize and remember particular spaces in the developing wall is more significant and more difficult. Each open space, whether large or small, presents certain opportunities and certain needs. Does it require something long to act as a partial through stone for stability? Something wide to break a joint, or several joints, in the course below? Can it stand to receive a relatively shallow face stone because the previous course features a stabilizing long one just underneath? Is the space circumscribed by flanking stones that will only admit a certain width between them? Do you need to match the thickness of a stone at one or both sides of the space so you can lay one over them in the next course? Does the spot have a natural cradle to it that will accept one of those tough-to-use loaves or balls? Here are Fuzzy Ducky’s threes and sevens galore!

By memorizing the requirements of two or three spots along your section, you equip yourself to make the choosing and placement of the stones that fill them a one-time transaction. If you know what you’re after each time you turn to the pile, it’s far more likely that you’ll be able to lay everything you pick up, and that you’ll be able to do so right away rather than embark, lugging, on an open-ended quest. Having more than one spot —more than one shape—in mind multiplies your chances of finding a good fit. This approach takes time to master, but it’s easily the single most important contributor to your efficiency and stamina as a builder.

Let practice be more important than progress

—for a while.

As an activity, stone wall building is more deliberate than strenuous. Its moments of straining effort, though regular, are not continuous and are generally separated from one another by stretches of time spent staring at what you've done while you contemplate your next move. While you're learning, these stretches will be longer than they are once you've gained some experience, and they should be. Impatience for progress ought to be resisted—all it can do is cause you to build badly. Your goal, at any rate, should be steadiness, not speed. As you become more familiar with it, you'll notice there's a certain rhythm to the work, slightly different for every builder but regular nonetheless. When you've been at it long enough to recognize this rhythm, you'll know you're well on your way to achieving genuine skill.

Concentrate.

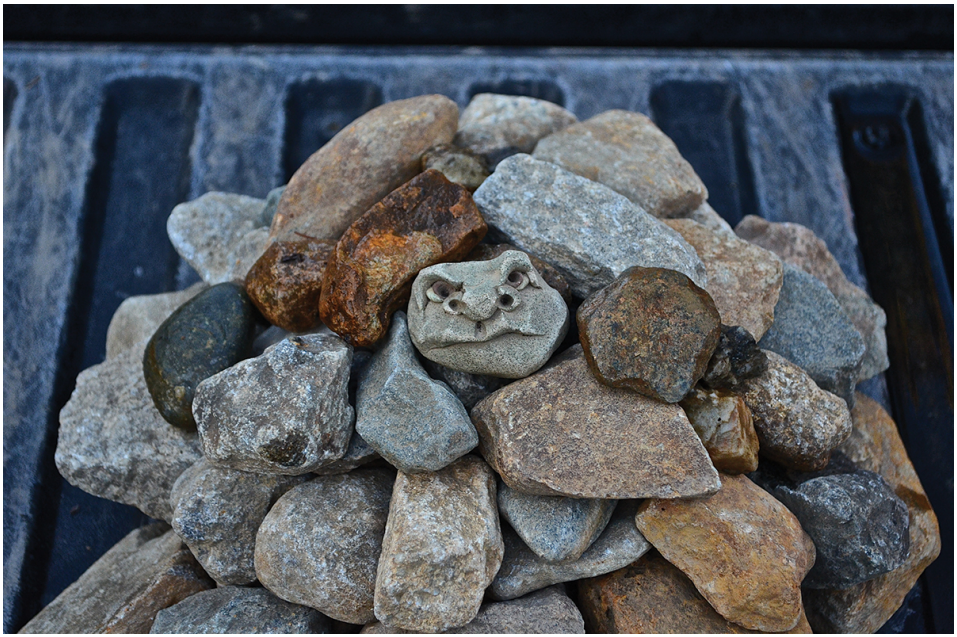
On the trip there, however, don't worry about what you accomplish in any given session. Concentrate on doing what you set out to do correctly, even to the point of willingness to dismantle parts of the ongoing project you don't like or can see have problems. Doing something over is far less discouraging than leaving a messy section unfixed to torture you forever with its structural deficiencies, its unattractiveness, or its premature breakdown. Sooner or later, things will start falling into place (in every sense) and your growing familiarity with both the physical and mental aspects of wall building will allow you to make reliable and regular progress.

Most of the time, that is. One of the oddest things about stonework is its unpredictable Good Day/Bad Day dynamic. Perhaps it would take a specialist in human cognition to explain why, no matter how much experience you have, days come along every so often when your ability to put stones together seems to entirely desert you. These episodes aren't common, but when they occur they are irresistible. Everyone seems to have them, even those who've been at it for many years, and the occasional appearances of the opposite kind of day, when every stone you touch seems to slip into a perfect position instantly and almost by itself, are cold comfort on the morning when you can't seem to match a stone to a space to save your very life. When this happens to you—and it will—don't fight it. Go do something else; haul more stone, dig the trench you've been putting off, take the kids fishing, anything. But don't be discouraged.

Whatever it is, it will be gone the next time you come out to build.

One of the paradoxes that makes stonework so fascinating (for some of us) is its simultaneous simplicity and complexity. The trick of assembling a big thing out of thousands of small ones, of tightly packing the infinite randomness of their shapes and sizes into a strictly defined space while observing the rules and techniques that produce integrated, long-lasting structures, can absorb your attention for hours, the way Legos or jigsaw puzzles do. Yet in the end, what have you got? A simple pile of stones—or so it seems.

CHAPTER 7



Mr. Grumpy Builds Three Walls

Mr. Grumpy comes from Rangeley, Maine, a gift from a humorous gentleman who attended my talk at the library there. Living now in one of the buckets of small stones I carry with me for model-making, he's become a kind of watchful household god, the *genius loci* of my stone supply. He's not very big, so his walls aren't, either, and although they photograph a bit like something observed by the Mars Rover, they do show both the interior and exterior details of their construction quite clearly. Here

he presents examples of the three principal types of New England stone walls, from start to finish.

The Single-Stack, or Farmer's Wall

1. To begin, Mr. Grumpy spreads his largest base stones out along the wall's line, spacing them somewhat unevenly to preserve a random look, and to ensure they won't dominate one section of the finished piece. He places the end pieces first, then lines up the rest by eye.

2. Now he completes the first course with stones that are a little smaller, but still hefty enough to support the wall's upper bulk. He's careful to lay them so their long sides run perpendicular to the wall's line, in order to make sure they offer as wide a platform as possible for what's coming next. There's no face to worry about in this kind of wall, so he doesn't care if ends stick out here and there, as long as each stone's center of gravity is as close to the wall's center as possible. With the second course, Mr. Grumpy looks to place individual builders over the joints between base stones wherever he can. He tries to make sure, from now on, that each stone he lays is settled on at least three separate contact points with the stones below and cannot rock or shift when touched. If the main builders don't quite touch each other from side to side, he fills in the space with smaller pieces to help keep the larger stones from slipping laterally over time.

3. As the wall grows, it becomes more uneven due to the mismatched sizes of its stones. Mr. Grumpy stops thinking of individual courses now, and concentrates on keeping the whole piece at more or less the same height regardless of how many stones it takes to get there. The stones are becoming a little smaller, too, because they will perch more soundly if they're not quite as wide as those supporting them.

As this happens, it's getting trickier to create good platforms for the wall's final courses. Mr. Grumpy looks for pieces with flatter upper surfaces to help him with this.

To finish off, he spots in some longer pieces along the wall's cap. These help stabilize the upper layers of the wall where the stones are smaller. In

between, he tries to even out the cap, not too fussily flat, but without obvious gaps. At a distance, its line will look consistent—voila!

A Double-Faced Wall

1. The “line” of a single-stack, straight or curved, lies in its center, but for double-faced work it moves to the outside edges. Mr. Grumpy sets strings to mark each of the wall’s faces before he lays the base. This ensures not just its straightness, but also that the wall’s width will remain consistent from end to end. Once again, the sizes and shapes of outside base stones are varied along both sides of the piece, but Mr. Grumpy takes care to avoid using any stones that are too shallow because they will be driven into the soil faster and less evenly than longer ones. Wherever he can, he tries to set his longest stones opposite but slightly offset from one another so that their tails will connect in the center, approximating the effect of a single through stone. He places each stone as close to the string lines as he can without touching them.

2. Even before all the outside stones are placed, Grumpy begins to

complete the interior part of the base. He looks for the largest pieces he can fit into the various spaces and lays their broadest sides down —they'll resist the settling pressure of the wall much more stoutly that way—but he's careful not to place anything in the center that's higher than the outside stones flanking it. He wants a level surface for the second course, not one that tilts outward. He'll continue this practice all the way up the structure.

3. Several courses later, the wall is beginning to define itself more sharply. Grumpy doesn't want it to look too fancy, so he's using stones in the face that aren't always perfectly flat. They look settled and organized, but roughly so. If this were a full-sized construction, his plane-window might be in the four- to six-inch range.

4. With a course and a half or so to go, Grumpy sets a cap string right down the center of the wall. As he begins to lay the capstones, he tries to cover as many joints between the supporting stones as he can and to use the thickest stones he can find that will still fit under the string without touching it.

5. When the cap is all but complete, Grumpy takes the string away. Any dips, cavities, or unevenness can be adjusted now if they draw the eye, but barring that, he's done!

A Retaining Wall

1. The retaining wall Mr. Grumpy decides to build will be a curved one, a large half-circle. Since convex curves are more challenging than concave ones, he ambitiously chooses the former. He drives a stake at the center point of the circle and, using a string and another stake to create an improvised compass, draws the base line on the ground. Grumpy lays out the line of the front—and only—face. Since this is an outside curve, he's already using base stones that are a little wider on the showing ends than they are back in the mass. He's making an effort to find stones, however, that still reach as far back underneath the wall as possible and don't taper too abruptly. This will help keep the wall's face from tilting forward as it settles and ages, or from spitting or squeezing its base stones out of line.

2. Before he starts to place the second course, he defines the inner line of the wall's backing mass. It's about as far inside the baseline as the finished cap of the wall is from the ground, making the structure's footprint equal to its height in the old fashioned way. But wait! While Grumpy is doing this, the client comes out with a new idea—she wants to add a set of steps to the piece, right in the center of the curve. Steps can be built as fully exposed structures entirely outside retainers, or as interior stairways contained within them. This one will be inset. Grumpy digs a shallow pit on the spot she indicates, fills it with riprap for extra stability under the first tread, and replaces a couple of his base stones with a pair of special flat pieces—the first treads—laid so they will run in under the corners of the sidewalls that bind the steps on each side. This will help integrate them with the wall as a whole.

3. As Grumpy builds up the wall, he continuously backs up each group of face stones all the way to the back of the mass behind. He's already beginning to set the layers of backing stone a little farther in with each course—it will eventually be battered up to a width far thinner than its heavy footprint. As the steps rise along with the wall, he does two things: he fills in behind each new set of treads almost to level with the stepstones, but not quite, and he brings up the sidewall corners and their returns simultaneously. The corners are slow going because he has to search for elusive stones with ninety-degree angles to them. He continues to set individual step stones in positions that run in under the sidewalls, and to make sure that succeeding sets of treads overlap the ones below just slightly.

4. As Grumpy adds more and more steps and courses, the classic triangular shape of the retainer begins to emerge. When he's within a few inches of the cap, he sets a string to guide the placement of its top stones.

5. Finished and filled with soil, most of the retainer's stone disappears below ground, including the backup mass for the steps themselves. Neat and tidy! But what's this?!? Oh, no! Mr. Grumpy got carried away—he's built himself right into the wall. Now he's *really* going to be grumpy. Oh, well. Guess he'll have to stay there for a while; the client thinks he looks rather handsome like that.

CHAPTER 8

This combination structure is a foundation, a retaining wall, and an enclosed stairway. The deck above is paved with large, irregular plates of natural stone.

Notes on Other Structures

Walls are far from the only dry-laid stone constructions built by New Englanders. Some of these have outlived their time and are rarely built today, while others have sprung up in response to more contemporary needs. Still others have historical pedigrees for one purpose but have been adapted to modern use for another.

With a single exception, however, they are all variations of the freestanding or retaining types of standard walling, so the techniques of building them are identical to those of more familiar structures in spite of purpose-specific differences in their individual configurations. The partial list that follows should give you some idea of the ways our infinite supply of stone has been put to work.

Causeways

Causeways are elevated roadbeds or trails that traverse gullies, marshes, or even waterways. They're simpler to build than bridges because they're solid structures—essentially two retaining walls laid back to back. The railroads erected immense causeways, sometimes running for miles, to keep their tracks relatively level or to cope with abruptly rising and falling grades in hilly country, but farmers also built them through swales or dips between fields to carry horse and wagon traffic, sometimes with a culvert at the bottom to keep water from backing up behind them. Their capacity to absorb enormous amounts of stone is not the least of their virtues.

The sidewalls of larger causeways were often battered to give them a wide and stable footprint, and though these causeways were mostly constructed of laid stone, they were generally topped off with layers of soil or gravel to smooth out the tracks. When built to carry wheeled vehicles, they tended to feature a bit of extra width on top so that wagons and tractors could avoid passing too close to the edges, where the extra pressure of their tires or wheels might dislodge or squeeze stones out of line. Rows of exposed heavy stones might be placed at intervals along the edges as well, to act as a kind of guard rail.

Combinations

Mixtures of the freestanding and retaining types in a single structure are common in both vernacular and formal stone wall construction and design. A barn foundation that emerges from its bank to become a freestanding livestock pen, a raised patio bound in by a retaining wall that's piggybacked with a low double-faced wall for sitting, a thick old double-face that shrinks by degrees to a snaggle-toothed single-stack as it passes into the woods: All are examples of this kind of hybrid construction.

There are few limits to recombinant walling except those of your imagination, but it's important to remember, when you're getting creative,

that certain kinds of wall need certain kinds of treatment no matter how they're being used. If you're going to build a retaining wall that rises above its bank as a freestanding one, for instance, the retaining portion of the structure should be configured not just to bear the extra weight, but also with a cap at least the same width as the footprint of the emergent freestanding section, if not a little wider.

Culverts

Before the appearance of iron, steel, concrete, and now vinyl culvert piping, stone-lined trenches under roads, driveways, and other spots were routinely constructed. The trick of a culvert is to conduct water harmlessly from one place to another without letting it back up and overflow on the upstream side or erode its downstream exit point too radically. Excavated trenches would be lined with stone, often in the form of heavy blocks, given beds of pebbles or larger stones, and roofed over with flat slabs before being buried under the road's surface gravel. Culverts can be petite —a foot across or so—or immense, large enough for people and even cows to pass through. Some of the spectacular examples built by railroads and other industrial operations feature vaulted ceilings and poured concrete stream beds, at dimensions large enough to drive a truck through.

A classic combination structure: A raised brick terrace with firepit is contained by a

retainer that emerges as a double-faced sitting wall above the terrace's surface.

Culverts also need *headers*, arrangements of stone around their entrances and exits to help usher flowing water into the culvert's opening and to prevent it from eroding the soil away from either end of its pipe or trench. Culvert headers are little sections of heavy retaining wall, frequently built as squares or rectangles all around, and even underneath, the openings. Like all stonework placed to contain or direct running water, they need to be thoroughly based below the surface grade and as deeply backed up as possible so they can't be easily undermined.

Fire Pits

Building an open fire in a hole, whether for cooking or just pleasant outdoor ambience, has been a longstanding tradition at beaches and campsites. Old-time New Englanders created underground cooking pits known as *bean holes*, in which an earthen pot full of beans, molasses, and a chunk of salt pork could bake for days, banked up with hot coals and almost entirely buried in a nearly airless environment which would sustain the slow fire. In recent years, fire pits have also found their way into back yards as part of recreational landscaping schemes. More formally constructed than improvised arrangements of rock and sand on a beach, they can be built either above or below ground, their walled-in fires contained and protected from the wind.

Stone lined below-ground fire pits are built like mini-foundations, with the faces of the retaining walls that define them looking in and their rougher back sides up against the edges of the excavation. Depending partly on the overall dimensions of the pit, these excavations can run from twelve or fourteen feet to as much as twenty-four feet deep. The deeper they are, however, the more space you'll have to add to the initial dig, because the footprints of the necessary retaining walls should be about as wide as the walls are tall. If, for example, you're planning a rectangular pit that will be three feet long by two feet wide and sixteen inches deep when complete, your initial excavation should be about sixty-eight by fifty-six inches (a little over five and a half by four and a half feet) in order to give you room for the stone. If you're also planning to extend the pit's walls above grade to form a bit of a barrier around the edges of the hole, be sure to modify the degree of battering on the walls' back sides to accommodate the width of any stone it's going to be asked to support.

Above-ground pits are entirely contained by what amount to short, freestanding walls. These can be tricky to build because of their relatively

small size, which doesn't tolerate oddly shaped stone very willingly. This is a case in which you may save considerable time by purchasing a supply that's pre-picked for consistency of size and shape, such as Pennsylvania Flat or another type that isn't very large and is dominated by flattened, angular shapes that fit together easily and well. The building will be easier, too, if you lay out these walls a little thicker than they need to be—even wider than the wall's planned height, in some cases—because it will give you more flexibility for placing individual stones, a great help when you're attempting a double-faced construction with small dimensions. You'll also increase the structure's longevity by capping it with the thickest, heaviest material it will accept—walls under twenty-four inches tall, whether double-faced or retaining, are far more vulnerable to early deterioration than larger walls because their lesser weight can't clamp down the structure's lower courses as stoutly as larger walls can, leaving them more prone to dislodgement and spreading.

Simplicity of construction can also be a consideration when you're deciding what kind of configuration your pit should have. Below-ground squares and rectangles are the easiest to build because of their single faces and the fact that their inside corners don't require stones with ninety-degree angles. Round or oval pits that are in-ground are also relatively easy, since their curving lines are all concave. But a freestanding above-ground rectangle or square will challenge you with its two faces and four outside corners, and a round pit of this type, with its continuous outer circumference, is the toughest of all.

Finally, before you build any fire pit, check on the applicable laws and regulations related to these structures, and to open burning generally, in your area. States, towns, and even individual fire departments and wardens publish and enforce laws and ordinances covering everything, including the size of the pit, its proximity to buildings and other structures, whether permits are required, and even when you may and may not light it up. These regulations differ from state to state and town to town. You can usually find them on municipal or state websites under Fire Safety or a similar title, but your local fire department will also be able to help with information.

Foundations

No one knows how many dry-stone foundations still exist across New England, but the number easily runs far into the thousands. Whether still carrying the houses, barns, mills, and outbuildings they were built to bear, or all but vanished under heavy blankets of leaf-fall and undergrowth in places where buildings haven't stood for well over a century, they contain some of the finest and most arresting stonework the region has to offer. From the simple squares and rectangles beneath early cabins to elaborate, multi-chambered full cellars under Colonial-era manors and nineteenth-century Yankee barns, replete with stairways, bulkheads, and massive elevated islands of stone or brick (sometimes arched) to support great central chimneys, the best of these structures rival even New England's magnificent dry-laid bridges as pinnacles of the stonemason's art.

Although some freestanding types were built, usually as emerging extensions under bank barns or as *mud sills* (very low supporting walls for buildings without cellars), most foundations are retaining walls. They frequently feature stones of considerable size, inherently more stable and also likely to be turned up during the extensive excavations for the cellars they enclose. Though many foundations are built using the heavy, wide footprints and classic triangular configuration of New England retaining walls, some that are dominated by particularly enormous individual stones don't bother with especially extensive interior bulk. Others may show both halves of boulders that were split in two, partly to create flat surfaces for the foundation's face and partly to make builders that were easier to move and set in place.

Because they were often constructed with more care than other kinds of wall work, and as they are protected from the elements by the buildings overhead, stone foundations generally endure very well. Some continue to stand essentially unchanged for many decades even after their buildings

have disappeared. Others suffer damage from the expanding roots of trees that spring up too close to, or even inside, their walls, or from the usual array of suspects: water, ice, settling, and catastrophic disturbances like earthquakes and blowdowns. The stones themselves can also deteriorate more rapidly if the building overhead was destroyed by fire, subjecting them to heat intense enough to crack them or cause extensive *spalling* (flaking off of large chips and shards from their exposed surfaces).

This restored foundation under one side of a small barn is half freestanding and half retaining. Its outside is built with a rounded batter, but inside it is flat and vertical.

Stone foundations under existing buildings can also sustain damage, sometimes from natural causes and sometimes from human ones. Indiscriminate removal of stones from certain sections of their faces, usually for additions like plumbing or electrical work, can create weak spots that lead to later collapse. Excavations too close to the building can disturb its foundation's interior support. Efforts to seal them against water entry, either with mortar (in a process called *pointing up*) or by the injection of foam or other sealants, while not generally damaging to their structures, certainly harm their appearance.

Maintaining a stone foundation can be an involved process. Small, simple blowouts can usually be repaired without too much trouble if they don't include anything much larger than a bushel basket, but major collapses or extensive bubbles over large sections of face frequently require rebuilding from the outside, especially when the cellar is home to a lot of mechanical equipment and doesn't offer much room to work. For foundations with considerable amounts of large stone, outside excavation is often the only way that machinery capable of moving it can be deployed. Generally speaking, this is a job for professionals, especially if the area to be repaired is extensive enough to require temporary support of the building while it is underway. The box-like rigidity of traditional timber frame structures does not demand the continuous support all along its sill that modern balloon framing must have, but for corners or sections of frame over eight feet or so in length that are carrying major wall posts (called *bents*), it does. Jacking up an old building and setting it on heavy cribbing is a matter of some delicacy, odd as that may sound. Consult

someone with experience before you try it, or better yet, hire their experience to do it for you.

Old stone foundations sometimes worry their owners unnecessarily. They are the productions of a different world, when cellars weren't full of electric equipment and self-activating furnaces. Their capacity to pass water, either in or out, strikes modern homeowners as a serious flaw, and the fact that their individual stones are not attached to one another with any adhesive or sealer gives rise to fearful fantasies that the entire structure will disintegrate someday and dump the house into its rocky hole. Specialist companies exist to pour conventional concrete shells into antique cellars, covering over walls and floor with impervious layers of liquid stone.

Most of the time, however, these anxieties are unfounded. Given the care and skill that went into the great majority of our antique foundations, and the length of time they have stood, it's very unlikely that sudden disastrous failure is anything like a present danger for most of them. Even those with visible anomalies, such as minor bubbles or a few missing stones, may well yet stand unchanged for another century or longer. The best thing to do if you're unsure about the condition of your old foundation is get an expert to take a look at it, and to cast an eye on it yourself from time to time. Unevenness here and there usually means nothing—but active, ongoing changes should be noted, as when larger stones begin to edge outward over the course below and don't stop, smaller ones shed themselves onto the floor from a single location, or noticeable amounts of soil and water begin to enter the cellar from a spot that didn't leak before. Even these more serious events, however, seldom indicate immediate emergency.

Mill Sites

Some of the most fascinating places to study old stonework are the sites of the innumerable small mills that sprouted all over water-rich New England in the eighteenth and nineteenth centuries. Unlike the industrial megaplexes that later appeared on major rivers in places like Lowell, Massachusetts and Manchester, New Hampshire, these local grist and lumber mills were scaled for small towns and even neighborhoods at a time when hauling capacity was tiny and transportation moved at a glacial pace, even over short distances.

Water power requires a directed stream that flows with a certain amount of force. To arrange for such a stream to pass over or under a water wheel on an axle that is connected to the gears and belts that turn

the grindstones or the saw blade means creating a foundation for the building that houses the machinery but also straddles or sits beside the spot where the stream flows fastest. Natural topography only seldom provides locations that perfectly favor this kind of arrangement, so the mill sites often acquired stonework that mixed and married features such as dams, foundations, sluiceways, mini-canals, and overflow chutes in all kinds of configurations to modify the existing stream bed and banks to support the mill's mechanical technology.

On most of these sites, everything is gone now but the stone. The pond is drained, the dam dry. Buildings burned or vanished long ago. Past floods have swept away or rearranged essential details, both natural and human-made. The stream, now unemployed, wanders where it will between the rough cut blocks of the old mill race and past the remnants of the shop foundation, no longer choking on the loads of chaff or sawdust it used to carry away downstream. The ruins are at once peaceful and mysterious, richly suggestive but often indecipherable. Even more than the farmers' old walls, they encourage the game of "What *is* this, and why is it here?" that so enlivens a walk through the old New England landscape.

Planters

Planters can be purpose-built from scratch, either as freestanding or retaining walls, or established in existing walls by scooping out portions of the interior capping to create a shallow trough. In any form, they are essentially raised beds, most useful as part of various hardscaping schemes or garden designs, or in places where the natural soil is inhospitable or downright hostile to bedding plants.

An orphaned section of an old sawmill's stonework slowly subsides into rubble. Is it a foundation, a spillway wall, both, or neither?

The Town Pound in Dunbarton, NH has a few blowouts in its side and back walls, but still it bravely shows its blocky face in nearly intact condition.

From a building standpoint, the trick with planters is to construct sidewalls that are hefty enough to contain the loose mass of soil within, but delicate enough to leave sufficient room for the root systems of the plants or shrubs they hold. When built as an enclosed, continuous retaining wall, they can be any shape—square, round, oval, rectangular—with the battered backside forming the containment structure for the soil and the vertical face showing out in front. Extra care should be taken with both placement and stone selection in the upper courses of these structures, however, because the customary mass of backing stone behind the face courses is likely to be thinner than it is in regular retainers, leaving them more vulnerable to displacement. We compensate for this by building them with stones a little larger than we might use in other kinds of retainers, and by arranging the battered back side almost as though it was another face, with similarly heavier individual stones than we use lower down. This backside "face" is also sloped more radically the closer it is to the top, so that plants near the outside edges of the structure will have enough soil to thrive without trying to send their roots down into a mess of inorganic rock.

When installing planters in pre-existing freestanding walls, make sure the wall is wide enough—at least thirty inches—to be able to withstand the removal of a sizeable amount of its interior packing down to a depth of, say, fifteen to eighteen inches without depriving the containing face stones of too much support. This will often require you to rebuild the portions of the wall that actually hold in the soil, and to replace some stones that run into the center too far.

When finished, planters made of dry-laid stone should be lined inside with landscape fabric to prevent rain and other watering from flushing away the soil among the stones of the structure. Sold under various names, this material allows water to drain through but prevents the passage of anything solid. It can be installed just below the edge of the soil line so that it doesn't show.

Pounds

New England's old town pounds are among the most common and characteristic remnant structures of the region's agrarian village landscape. Compared with many other stone enclosures of their time, they're also the most thoroughly understood. Because they were public facilities erected primarily by towns, surviving records often tell us when they were built, their original costs and dimensions, and even the names of the builders, information that is unavailable for the vast majority of New

England's antique stone constructions.

Pounds were holding pens for the temporary incarceration, or impoundment, of stray farm animals. Aside from their value to their owners, livestock could also constitute a destructive threat to crops and other animals when allowed to run loose. Town governments included official positions with titles like pound keeper, fence viewer, and hog reeve to help maintain order in the countryside. Those whose cattle or pigs got loose and proceeded to help themselves to someone else's corn might find the offenders locked up in the pound until they were ransomed by the payment of damages or a municipal fine. Animals could also be impounded for various offenses of their owners, such as tax delinquency.

Almost every farming town had at least one pound, some as many as four. Early ones might be built of rough-hewn logs or split rails, but stone quickly became the material of choice for pound builders because its strength and durability made it more reliable and, in the long run, more economical. Designs varied, but not a great deal—one of the notable things about pounds is how much alike they are from town to town. Most are square or nearly so, and though their dimensions can run from twenty feet or so per side to well over forty feet, the standard seems to be about thirty feet. Some communities opted for round pounds—Milton, New Hampshire and Orrington, Maine are two examples—but the thirty-by-thirty-foot square repeats itself so often in town after town all over New England that it recalls the kinds of traditional templates that produced broad likeness in other common structures, such as one-room district schoolhouses or the strings of attached buildings on so many New England farms.

The stonework in the pounds varies a little more than their basic configurations, due partly to the nature of available stone supplies and partly to individual builder preference. Some are composed largely of heavy split blocks or natural boulders, and some are more finely fitted with much smaller stones, or with mixtures of large and small. Wall heights also vary—though many pounds featured walls up to six feet tall or more, others were capped off at four feet, perhaps augmented by a layer of heavy timbers laid over the stone. Pounds typically had a single gated opening, often wider than a standard doorway to admit larger animals, and frequently carrying a stone or timber lintel to connect the freestanding butt ends on either side. Most pounds were built very heavily—footprints of their walls commonly run to four to six feet in width, and they sometimes appear to be as massive as house foundations, with vertical interior walls and a battered outside rising roughly to a narrower cap.

Because of their emblematic status as icons of New England's long-gone days of small farm dominance, and the frequent availability of documentary provenance associated with them, pounds in many places

have been the beneficiaries—or victims—of various attempts at historic restoration over the years. Signs, plaques, and even notices carved into the stone itself announce the structure's rehabilitation by the D.A.R. in 1916 or the Civic Club in 1933. A small flurry of town pound refurbishment, mostly amounting to brush-clearing and trash pickup, occurred around the time of the American Bicentennial in 1976. Still, not a few of the old enclosures are derelict, collapsed into barely recognizable mounds that reveal what they once were mostly because of their shape.

Ramps

Stone ramps became a fixture on many New England farms, especially after preference in barn design moved away from the small, side-entrance English barn to the larger, gable-doored Yankee style. Some of these were large enough to reach the buildings' second floors, allowing workers to drive wagonloads of hay right into the mow for unloading, then out again at the other end without having to turn around.

Like causeways, ramps are almost solidly composed of stone, built like back-to-back retaining walls with a roadbed of gravel laid over the top. Their degree of rise had to be fairly gentle to accommodate heavily-loaded horse-drawn vehicles, so they could sometimes be almost as long as the barn itself if they were built to reach its upper story. At the Shaker Village in Canterbury, New Hampshire, the two immense ramps that flanked the village's largest barn still stand facing one another, though the barn burned some years ago. All by themselves now at the ends of a huge empty space, they look like something built for a spectacular motorcycle jump by Evel Knievel.

Steps and Stairways

According to Ted Williams, the first rule of hitting in baseball is "Get a good pitch to hit." When it comes to building stone steps, the corollary rule might be "Get good treads to lay." *Treads* are the business part of steps, the surfaces where you put your feet. In wooden stairways they're kept in place by *risers*, the vertical portion of the step that holds up its outer edge. In stone steps these components are combined in the same object (most of the time), a fact that makes selection of treads one of the most important parts of step building. Stability and consistency are the primary objectives; individual treads must be pinned in place or too heavy

to move no matter how you step on them, the lifts from one step to the next must be even or very close, and side-to-side fitting must be as tight as possible between treads in the same step, especially at its leading edge.

An ideal tread is about six to eight inches thick and more or less rectangular, with strong, square edges and a flat or sheared surface on at least one of its broad sides. It's long enough not only to form the full depth of the step it's part of but to pass back underneath the leading edge of the tread or treads in the step above. It is also heavy—eighty to one hundred pounds at minimum. Ideal tread pieces, however, are never as numerous in average runs of fieldstone as you'd like them to be, so alternative strategies are often necessary.

When individual steps are fitted together from several pieces of natural fieldstone, the search for workable treads can be challenging. Single steps can be created in two layers (as in the second and third steps of this example), or out of single stones (as in the first, fourth, and fifth). Sometimes your friendly neighborhood stone supplier carries palletized collections of step-stones, or selected large and flattish fieldstones, that can save you considerable time if your own pickings are slim. It's also possible to create your treads out of other types of stone more suited to the task, like long pre-cut slabs of granite or bluestone. Here's a sizeable stairway with treads made of old rough-split fence posts.

Steps can be built as freestanding structures, like the stile at Stark Cemetery, but attempting them with random fieldstone is tricky because the outside treads must serve as both containment and face for the entire

bulk of the stairway, a job that makes their selection and placement far more demanding. Embedded in a retaining wall, they are considerably easier, and more forgiving, to build.

In fact, steps are themselves a form of retaining wall, each course offset to the inside as the structure rises along with its containing sidewalls. The challenge is to build steps, sidewalls, and the corners at the opening all at once, while maintaining the mass of backing stone more or less level with each new step as you go. This allows you to weave the separate elements together in a way that stabilizes and strengthens them all. Base corner stones on either side of the opening should thus be laid partly over the first step on either side, and step treads can be built right into the sidewalls at the edges to help pin the treads down and to serve as bases and buttresses for subsequent courses of the sidewalls themselves.

Stiles

Stiles provide crossing points for people over walls in places where there is no opening. Whether made of wood, or built right into the wall, they are often constructed to befuddle animals while allowing humans to pass through. A simple step-stile built into this low wall takes a sharp turn to the right after its first tread, preserving the solid visual barrier of the wall as a whole, but providing convenient footing for anything with only two legs.

Built-in stiles are more common elsewhere than in New England's traditional stonework. It's hard to say why. Perhaps there were more of them in the old days than we see now, constructed of wood which has long since returned to dust. Perhaps the historical absence of commonly held land in New England's tradition of free individual ownership meant that fewer people walked cross-lots on a regular basis. Or maybe the old farmers simply preferred gates and barways. The elegant step-stile over an iron fence at Dunbarton, New Hampshire's Stark Cemetery (where poet Robert Lowell lies buried) is ironically exemplary. Though it provides easy access to any visitors, it's entirely unnecessary—there's an unlocked gate in the same fence just a few feet away.

Walks and Patios

Surfaces paved with stone or brick, whether as walkways from one place to another or as broader patios or terraced areas for recreation and sitting, are mostly features of modern hardscaping schemes these days. Contemporary builders lavish considerable time and expense on site preparation for these features, often excavating to depths of six or eight inches and replacing natural subsoil with layers of compacted gravel or crushed stone, carefully leveling the new bed, and laying out elaborate, precise patterns with whatever surface material they're installing. When that material consists of bricks or small or very thin pieces of stone, it's not a bad idea to take some care with the underlayment so that each piece of the deck will be fully supported on a flattened, compressed surface. Applications of *stone dust* (ground granite or other stone) help to hold everything in place by acting as a kind of dry mortar in the cracks between individual pieces. Stone dust is heavy enough not to wash away as sand would and tends to compress itself over time.

Builders of former days created walks and paved areas, too, but their methods were quite a bit simpler. Most of their efforts were not intended as recreational or aesthetic landscaping, however, but as attempts to defeat mud season and the general tendency toward sloppiness afoot in country dooryards. To this end, they laid out pathways of natural stone or roughly paved landings at the door simply by interring each stone in a shallow reverse-impression hole exactly the size of the stone itself. Trails

of single stones would suffice, or they might create double or triple lines or even more carefully fitted patterns now and then. The Shakers of Canterbury, New Hampshire installed hundreds of feet of generous walkways between buildings in their central compound using enormous, quarried slabs of schist four feet wide and up to twelve feet long.

And that's the key to the old way of paving—size of material. Complex site preparation is unnecessary when the stones are too heavy to rock or shift underfoot. Setting them individually also means they don't have to be of uniform thickness. If they have one good, flat side, you can sculpt the hole to accommodate the underside no matter what its shape may be. On average, they should reach or exceed eighty to one hundred pounds, just like exposed step stones. Bulk matters more than dimension: Broader stones can be slimmer and still lie stably, while smaller ones should be thicker to make up the difference in weight.

If I want to lay out the pattern before I start setting individual stones, I just arrange them all in the spots I like before digging any of them in. Then, one at a time, I cut into the surrounding turf with a spade (an ice chipper works well for this, too) right against the edges of each stone all the way around, flip it off the spot, and dig away the turf inside my marked area to the depth and shape of the stone itself. Then I flip it back in. It's easily removable if I need to adjust my hole in any way. I'm looking to set the edges of the stone right at the line where the soil begins, or even just slightly below so there'll be no sharp thresholds sticking up to catch unwary feet. If my excavation has been too enthusiastic, I can add back some of the dirt I've taken out, or jam it into any spaces around the edge using the tip of the spade handle.

There's a nice rusticity to this way of doing walks and patios, especially when they're made of unmatched, weathered fieldstone. If you lay them carefully enough into the surface, you can simply leave the grass to grow in between the stones and mow right over the whole thing. Be careful with your initial layout if you're a superstitious type, however—it's been said that bad luck ensues if any sharp points on your selected stones are laid aiming toward the house.

Wells

There's no longer much demand for the stoning up of water wells these days, but the technique remains useful in another context. On construction sites where grades must be substantially raised but existing trees must be saved, they are still constructed in order to avoid burying the trees' boles and lower trunks too deeply, which will eventually suffocate and kill

them. Stone linings in wells are circular retaining walls, as described in Chapter Three. This one will be built where road construction and a new sidewalk have necessitated raising the grade around a good-sized maple.

We start by defining the wall's base on the low side of the well. With a couple of courses in, it's evident that we're able to show the thinner ends of some—but not all—of the stones on the inside surface of the well. The

base is thicker on the downhill side only because the tree is too close to the sidewalk to give us room for that much backing on the uphill side. We try to keep raising the supporting bulk of the structure right along with each new course of inside face stones so that new platforms for courses yet to come will be constantly created.

Nearing the top now, the full shape of the structure is emerging. Because it's a retaining wall, it's much more thickly backed up at its base than above, so it takes on a kind of taper—the "batter"—as it rises. We'll fill in all the little spaces between larger stones with jagged little chunks of riprap to keep them from moving around too much as the piece settles over time.

Finished and backfilled, the bulk of the structure disappears, leaving only the peak of the stonework, now dressed off with a little one-inch riprap. The stonework looks exactly like an old water well, and the tree will survive.

AFTERWORD

The Elements of (Personal) Style

Early on in my apprentice years, I began to notice that different wall builders produced different-looking walls even when the stone supplies they worked with were more or less alike. The essential principles of dry-laid construction allow considerable latitude in the placement and mating of shapes, and New England's wild, ex-glaciated mess of rounded, sheared, shattered, and poly-angular stones expands this latitude even further.

Still, I was curious about what these builders were doing that achieved such markedly personal results even with materials and techniques that were all but identical.

Eric Sloane is not the only commentator to note there was once a time when people were familiar enough with the styles of local builders to identify their work on sight. This may have had as much to do with the social facts of life in small rural communities as with distinctions among individual building practices, but it certainly points to a time when the patterns and principles of dry-laid stonework were far more widely understood than they are now. Attributing a wall's style to an individual builder isn't always that easy, even when you know what you're looking for. Older work changes its aspect over time, ordinary deterioration slowly erases signature patterns, and even walls that have been maintained are often kept up at the expense of the original builder's characteristic placements.

A friend called me a little while ago to assess a couple of walls in need of repair at his home. One was a tumbled heap of roadside wreckage, a

remnant single-stack from the lot's long-ago days as farmland, and a major rebuilding job. The other was something very different: a short, neat, rectangular garden wall, about two feet square, right next to the house. There wasn't much wrong with it—a few disturbed capstones and a loosened corner were all that needed looking after—but the longer I stared at it, the more familiar it seemed.

It was one of my own. My family and I had built it for the house's original owner more than twenty-five years ago. I'd just forgotten. My famously unreliable memory eventually recovered the circumstances of the wall's construction—we did it as subcontractors for a local landscaper—but it was the wall's style that made its recognition possible.

There are two ironies here. One, of course, is that I could stare at a wall as long as I stared at this one without knowing that I was one of its builders. The other is that it was the wall's style that finally made me realize the truth.

This is because the "style" I learned from my Uncle Derek is no style at all. It's a deliberate effort to avoid personal distinction, to achieve anonymity, to make what we build blend into the landscape without revealing its contemporary origins—in other words, to mimic something old. In trying to describe this style, I've said it makes its stones look comfortable, not laid at haphazard, clashing angles but with orderly consistency, each stone's visible center of gravity on the low side and straight edges running parallel to the baseline of the structure wherever possible. To the extent that I had to stare at this wall for ten minutes or so before I knew it was mine, we succeeded in achieving a certain anonymity in this case. But we also failed, as we must, because it is impossible to build things with dry-laid stone for a long time without falling into habits and preferences that collectively constitute a style—even when your objective is style-lessness. Every single stone in this wall was in a spot where I would have put it. After a while, even a knucklehead like me had to admit what that meant.

Some styles are deliberate. One builder whose work I know strives mightily to compose the patterns of his walls in strictly horizontal and vertical lines. This leads him to emphasize squares and rectangles in his stone collecting, and it results in a grid-like style that resembles a painting by Piet Mondrian. Confining stone selection to a narrow range of shapes is certainly one way to achieve a recognizable style. But it's also a privilege of modern builders, who are not obligated to dispose of large amounts of randomly formed stone as they build their walls. A great builder like Vermont's Dan Snow is able to take advantage of selectivity while also creating an impression of inclusiveness that gives his work a natural feel even within a highly-composed pattern. But this is advanced style-making of a very high order. For a majority of wallers, style is a thing that

emerges, not one that's planned, implemented, or imposed.

Most beginner builders pass through a more-or-less chaotic stage of choice-making when it comes to placing stones. At first, the material is in control of you, not the other way around. But sooner or later, you'll begin to see things in your developing projects that you've seen before. When this happens, it's almost inevitable that you will begin to address similar situations in similar ways. Spaces of particular shapes will be filled the same way wherever they occur. The distribution of large and small stones will become consistent from project to project. Mistakes—laying stones on edge, laying the shallow side out, over-reliance on chinking—will diminish, as will visual anomalies like running joints or awkward dimples between mismatched stones. If you stay with it long enough, consciousness of what looks right to you and what doesn't will set in. Once this occurs, for better or worse, you'll have a style.

"When I start building, I don't set out to make a beautiful wall," says Dan Snow. "My intention is a lasting structure." If there's any better advice for those who want to try this most humble, yet deceptively complex, art, I haven't seen it. Good luck!

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Hopkinton, NH
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